FORTY-SIXTH ANNUAL REPORT

OF THE

Maine Agricultural Experiment Station

ORONO, MAINE

1930

UNIVERSITY OF MAINE

1930

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

ORGANIZATION JANUARY TO JUNE, 1930

THE STATION COUNCIL

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[1]ASSISTANT DIRECTOR FRED GRIFFEE,	Secretary
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WILSON H. CONANT, Buckfield,	State Pomological Society
JOHN W. LELAND, Dover-Foxcroft,	State Dairymen's Association
EDGAR B. LORD, West Lebanon,	Maine Livestock Breeders' Ass'n.
WILLIAM G. HUNTON, Portland,	Maine Seed Improvement Ass'n.

And the Heads and Associates of Station Departments, and the
Dean of the College of Agriculture

THE STATION STAFF

Administration
Warner J. Morse, Sc.D., Director
[3]Fred Griffee, Ph.D., Assistant Director
Charles C. Inman, Administrative Assistant
Mary N. Cameron, Secretary
Rose H. McGuigan, Clerk and Stenographer
Lillian M. Marquis, Clerk and Stenographer
Irvill H. Cheney, B.S., Superintendent of Highmoor Farm
Silas O. Hanson, Superintendent of Aroostook Farm

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Charles H. Merchant, Ph.D., Head of Department
George F. Dow, M.S., Associate Economist
William E. Schrumpf, M.S., Assistant Economist
Merton S. Parsons, B.S., Assistant Economist
Elaine M. Pooler, Chief Assistant
Magretta Blackmore, Assistant
[4]Rebecca E. Harding, Assistant
Dorrice E. Smith, Assistant

Biology
Fred Griffee, Ph.D., Head of Department
John W. Gowen, Ph.D., Collaborating Biologist, Animal Breeding
[5]Forrest V. Owen, Ph.D., Associate, Plant Breeding and Nutrition
W. Franklin Dove, Ph.D., Associate, Animal Breeding and Nutrition
Aubrey C. Hildreth, Ph.D., Associate, Blueberry Investigations
Iva M. Burgess, M.S., Assistant
Mildred R. Covell, Assistant
[6]Eva L. Jolivette, B.A., Assistant
Frederick B. Chandler, B.S., Assistant, Blueberry Investigations
Delmar B. Lovejoy, B.S., Assistant, Plant Breeding and Nutrition
Emmeline W. Kenney, Laboratory Assistant
[7]Madeleine F. Cotter, Laboratory Assistant

Chemistry
James M. Bartlett, Sc.D., Head of Department, Inspection Analyses
Elmer R. Tobey, M.S., Ch.E., Research Chemist
C. Harry White, Ph.C., Associate, Inspection Analyses
Bernie E. Plummer, M.S., Assistant, Inspection Analyses
[8]*Willard B. Stone, Assistant Chemist

Entomology
Edith M. Patch, Ph.D., Head of Department
Clarence R. Phipps, M.S., Associate
John H. Hawkins, M.S., Assistant
Alice W. Averill, Laboratory Assistant

Home Economics
Pearl S. Greene, M.A., Head of Department
Marion D. Sweetman, Ph.D., Associate
Gail M. Redfield, M.S., Assistant

Plant Pathology
Donald Folsom, Ph.D., Head of Department
Reiner Bonde, M.S., Associate
Florence L. Markin, M.S., Assistant
Gladys E. Babbin, Laboratory Assistant and Seed Analyst

[1]Effective at Station Council Meeting, April 30.
[2]Effective at Station Council Meeting, April 30.
[3]Effective May 1.
[4]Resigned May 17.
*Temporary appointment.
[5]Resigned April 10.
[6]Resigned March 30.
[7]Beginning February 15.
[8]Beginning June 16.

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[1]Beginning October 10.
[2]Resigned July 10.
*Temporary appointments.
[3]Beginning July 21.
[4]Resigned September 30.
[5]Beginning September 15.

The publications of this Station will be sent free to any address in Maine. All requests should be sent to

Maine Agricultural Experiment Station,
Orono, Maine.

CONTENTS

ANNOUNCEMENTS

Establishment of the Station

The Maine Fertilizer Control and Agricultural Experiment Station, established by Act of the Legislature approved March 3, 1885, began its work in April of that year in quarters furnished by the College. After the Station had existed for two years, Congress passed what is known as the Hatch Act, establishing an agricultural experiment station in every state. This grant was accepted by the Maine Legislature by an Act approved March 16, 1887, which established the Maine Agricultural Experiment Station as a department of the University. The reorganization was effected in June, 1887, but work was not begun until February 16, 1888. In 1906, Congress passed the Adams Act for the further endowment of the stations established under the Hatch Act. The Purnell Act, passed in 1925, has materially increased the Federal support of the experiment stations in the several states and broadened the scope of their activities.

The purpose of the experiment stations is defined in the Act of Congress establishing them as follows:

"It shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the Physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantage of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manure, natural and artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard

to the varying conditions and needs of the respective states or territories."

The work that the Experiment Station can do under the Adams Act fund is more restricted. This fund can "be applied only to paying the necessary expenses for conducting original researches or experiments bearing directly on the agricultural industry of the United States, having due regard to the varying conditions and needs of the respective states and territories."

The purposes for which the funds provided by the Purnell Act may be used are stated as follows: "The funds appropriated pursuant to this Act shall be applied only to paying the necessary expenses of conducting investigations or making experiments bearing directly on the production, manufacture, preparation, use, distribution, and marketing of agricultural products and including such scientific researches as have for their purpose the establishment and maintenance of a permanent and efficient agricultural industry, and such economic and sociological investigations as have for their purpose the development and improvement of the rural home and rural life, and for printing and disseminating the results of said researches."

INVESTIGATIONS

In its investigational work, the Station does not attempt to cover the whole field of agricultural science—with the funds and facilities available, this is impossible. It does attempt to study thoroughly the more important problems connected with a permanent and profitable agriculture for Maine and, as far as changing times will permit, to anticipate these problems in advance. As in the past, diseases of plants and animals, insect pests, breeding of plants and animals, orchard and field experiments and poultry investigations continue to be important lines of research. As the result of additional funds provided by the Purnell Act, together with a State appropriation for general maintenance, it has been possible to strengthen existing departments, to resume work upon problems or phases of problems of a chemical nature and to establish departments of agricultural economics and home economics with comprehensive programs of research in these important fields.

INSPECTIONS

The State Department of Agriculture is charged with the enforcement of all laws regulating the sale of agricultural seeds, apples, commercial feeding stuffs, commercial fertilizers, drugs, foods, fungicides and insecticides. The Station is required to make the analyses of the samples of these various materials collected by the inspectors of the Department. The Station is also required to test and mark the graduated glassware used by creameries. The cost of the inspection work is borne by fees, and by a State appropriation.

OFFICES AND LABORATORIES

The offices, laboratories and poultry plant of the Maine Agricultural Experiment Station are at the University of Maine, Orono. Orono is the freight, express, post, telegraph and telephone address for the offices and laboratories.

The old poultry plant has been replaced by a new one which is bigger and more modern in every detail. The new plant is on a ten-acre lot which is inclosed with fox wire fence. The main building is 50 feet by 40 feet and two and one-half stories in height. The main floor has three rooms for grain storage providing for storage of two car-loads of feeds. An electric grain mixer provides for mixing thoroughly 1000 pounds of feed in three minutes. A fireproof record room is also provided. There is a wing 162 feet long and 20 feet wide on each side of the main building. One wing has eight pens 20 feet by 20 feet, each with a capacity for 100 hens. The other wing has 16 pens 20 feet by 10 feet designed for mating and breeding purposes. The equipment includes the King system of ventilation, thermostatic control for the chick room, New Hampshire batteries, a 6000-egg electric incubator, and other items of modern design. The new building is one of the best designed for poultry research work at any station.

The Home Economics Department has been provided with modern quarters in Merrill Hall. This new building provides space for a chemistry laboratory used in food analyses, an animal room where small animals may be kept for use in vitamin studies under controlled conditions, a respiration room for studies with

human beings, and a household equipment laboratory. There is a research office located in the main wing of the building and connecting with these laboratories.

AROOSTOOK FARM

By action of the Legislatures of 1913 and 1915 a farm was purchased in Aroostook County for scientific investigations in agriculture to be under "the general supervision, management, and control" of the Maine Agricultural Experiment Station. The farm is in the town of Presque Isle, about 2 miles south of the village on one of the main roads to Houlton. The Bangor and Aroostook Railroad crosses the farm.

The farm contains approximately 275 acres, about half of which is cleared. The eight-room house provides an office and home for the farm superintendent. A school house on a lot adjoining the farm was presented to the State by the town of Presque Isle and after being remodeled served as a boarding house for the help. This was destroyed by fire in the fall of 1925 and was replaced by a new building in the spring of 1926. A greenhouse and a potato storage house have been erected at the farm by the U. S. Department of Agriculture for use in co-operative work on potato breeding. The large barn affords storage for hay and grain and has a large basement suitable for potato storage.

HIGHMOOR FARM

The State Legislature of 1909 purchased a farm upon which the Maine Agricultural Experiment Station was directed to "conduct scientific investigations in orcharding, corn and other farm crops." The farm is situated largely in the town of Monmouth. It is on the Farmington Branch of the Maine Central Railroad, 2 miles from Leeds Junction. A flag station, "Highmoor", is on the farm.

The farm as originally purchased includes 225 acres, about 200 of which are in orchards, fields and pastures. About 30 acres of additional orchard land, adjoining the farm, was purchased in July, 1925. There are in the neighborhood of 2,500 apple trees of all ages upon the place. The house has two stories with a large

wing, and contains about 15 rooms. It is well arranged for the Station offices and for the home of the farm superintendent. A substantially constructed building for apple packing was erected in 1912.

The removal of the crossbred herd from the University to Highmoor necessitated considerable change in the barns and the building of a new one 80x36 to accommodate the herd.

PUBLICATIONS

The Station is organized so that the work of investigation is distinct from the work of inspection. The results of investigation are published in the bulletins of the Station and in scientific journals, both foreign and domestic. The bulletins for the year make up the annual report. The results of the work of inspection are printed in publications known as Official Inspections. These are paged independently of the bulletins and are bound with the annual report as an appendix thereto. Miscellaneous publications consisting of newspaper notices of bulletins, newspaper bulletins and circulars which are not paged consecutively and for the most part are not included in the annual report, are issued during the year.

BULLETINS ISSUED IN 1930

No. 354. Sources of Nitrogen for Potato Fertilizers in Aroostook County. (In cooperation with the Bureau of Chemistry and Soils, United States Department of Agriculture.) 38 pages.
No. 355. Local Market Requirements of Agricultural Products in Aroos-, took County, Maine. 68 pages.
No. 356. Blueberry and Huckleberry Insects. 126 pages.
No. 357. Abstracts, Finances, Meterology, Index. 23 pages.

OFFICIAL INSPECTIONS ISSUED IN 1930

No. 135. Foods and Drugs. 8 pages.
No. 136. Commercial Feeding Stuffs, 1929-1930. 28 pages.
No. 137. Commercial Fertilizers, 1930. 28 pages.
No. 138. Commercial Agricultural Seeds, 1930. Fungicides and Insecticides, 1930. 44 pages.

PUBLICATIONS FROM THE AGRICULTURAL ECONOMICS LABORATORY IN 1930

Local market requirements of agricultural products in Aroostook County, Maine. By Charles H. Merchant and Byron T. Smith. Annual Report of the Maine Agricultural Experiment Station, Bull. 355, pp. 39-106.

PUBLICATIONS FROM THE BIOLOGICAL LABORATORY IN 1930

Sources of nitrogen for potato fertilizers in Aroostook County. By B. E. Brown, F. V. Owen, and E. R. Tobey. Annual Report of the Maine Agricultural Experiment Station, Bull. 354, pp. 1-38.

PUBLICATONS FROM THE ENTOMOLOGICAL LABORATORY IN 1930

Tarsal claws of noctuid larvae. By John H. Hawkins. Annals of the Entomological Society of America 23:393-396.

Wireworm control in Maine. By John H. Hawkins. Journal of Economic Entomology 23:349-352.

Blueberry and huckleberry insects. By Clarence R. Phipps. Annual Report of the Maine Agricultural Experiment Station, Bull. 356, pp. 107-232.

PUBLICATIONS FROM THE HOME ECONOMICS LABORATORY IN 1930

Color of potato chips as influenced by storage temperatures of the tubers and other factors. By Marion D. Sweetman. Journal of Agricultural Research 41:479-489.

PUBLICATIONS FROM THE PHYTOPATHOLOGICAL LABORATORY IN 1930

Effect of seed-potato treatment on yield and Rhizoctonia in northeastern Maine from 1925 to 1928. By E. S. Schultz, L. O. Gratz, and Reiner Bonde. Phytopathology 20:47-64.

Some conditions determining potato seed-piece decay and black leg induced by maggots. By Reiner Bonde. Phytopathology 20:128.

The cabbage maggot as a disseminating agent of bacterial rots in the Cruciferae. By Reiner Bonde. Phytopathology 20:128.

Net necrosis versus stem-end browning in Aroostook potatoes. By Donald Folsom. American Potato Journal 7:251-256.

STATION NOTES

COUNCIL AND STAFF CHANGES

At the 1930 Station Council meeting Doctor Fred Griffee served as secretary, Director Morse being absent due to ill health.

At a meeting of the Board of Trustees of the University of Maine on May 1 Doctor Fred Griffee was made Assistant Director of the Station, effective from that date.

Mr. Frank A. Potter of Bangor succeeded Mr. Eugene H. Libby as representative of the State Grange on the Station Council.

The following changes in the Station staff occurred during the year:

In Agricultural Economics, Miss Rebecca E. Harding resigned as assistant May 17 and was succeeded October 10 by Miss Dorothy I. Bither.

In Biology, Doctor A. C. Hildreth resigned as associate in charge of blueberry investigations on July 10. Doctor F. V. Owen resigned as associate, plant breeding and nutrition, on April 10 and was succeeded by Doctor J. A. Chucka on July 1. Miss Eva L. Jolivette resigned as assistant on March 30 and was succeeded by Miss Elizabeth F. Murphy on July 21. Miss Madeleine F. Cotter was appointed laboratory assistant on February 15.

In Chemistry, Mr. Willard B. Stone was appointed assistant in research to assist in carrying on Mr. Tobey's work, Mr. Tobey being absent from the Station on leave of absence. This is a temporary appointment extending from June 16, 1930, to September 1, 1931.

In Home Economics, Miss Gail M. Redfield resigned as assistant on September 30. Mrs. Myrtle Walker Dow was appointed part-time assistant on September 15. This is a temporary appointment covering a period of nine months.

(Bulletins 358 to 360 constitute the Report for 1931. In binding, pages i to ix at the end of this bulletin should be detached and placed before Bulletin 358 which begins with page 1.)

Maine Agricultural Experiment Station

ORONO

BULLETIN 360 DECEMBER, 1931

Progress of Investigations, Abstracts of Papers not Included in Bulletins, Finances, Meteorology, Index.

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Bell Dall, Clerk

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INTRODUCTION

The agricultural experiment station was organized for the purpose of coping with the problems of the producer. It is during times of stress that the results of research are of the greatest importance. Particularly is this true of those investigations having for their purpose the improvement of quality and the lowering of net cost of production. The investigations of this Station cover a wide variety of subjects. A brief report of the progress on these various studies is given. Complete results of these studies are published in bulletin form as soon as the data warrant the drawing of definite conclusions.

AGRICULTURAL ECONOMICS

Prices of Farm Products and Price Trends in Maine. Charles H. Merchant, George F. Dow, and William E. Schrumpf. For five years attention has been given to the collection of information on prices received for farm products by producers. During the past year the material on prices has been brought together and analyzed. Continuous monthly prices of farm products and price indices for the more important agricultural products of Maine have been compiled. Many of these price series cover the period from 1852 to date. The commodities for which records extend back to this early period are corn, oats, apples, potatoes, hay, hogs, lambs, wool, butter, chickens, and eggs. These prices and graphs showing conditions during the Civil War and World War periods are in manuscript form.

Tables have been prepared giving the purchasing power of the principal farm products in Maine. These include the purchasing power of various classes of livestock per head and crops per acre. It is of interest to mention that in the case of livestock there is a tendency for Maine prices and purchasing power to move in fairly regular cycles. In general these cycles conform rather closely with those of the country as a whole.

Information on acreage and production of crops and number and value of livestock has been assembled for the period 1867 to

date. This information indicates the trend which has taken place during the past sixty-five years. The trends in Maine have been compared with the trends which have taken place in the United States during the same period.

Considerable information pertaining to the agricultural situation has been collected and analyzed. This material includes wholesale and retail prices, farm wages, transportation charges, farm taxes, and real estate values. This part of the study is presented in order that farmers and others interested in agriculture may better understand the agricultural conditions and relationships existing during periods of prosperity and depression. All the material on the agricultural situation has been collected and analyzed and is now ready to be included in a manuscript.

FARM TAXATION IN MAINE. Charles H. Merchant. Considerable interest has been manifested in the study of farm taxes in Maine. The farmer pays taxes directly or indirectly in the support of local, county, state, and federal governments. If certain apparent maladjustments relative to taxes are allowed to continue, it will doubtless bring about an undesirable agricultural condition in many of our rural communities. Due to the importance of this widespread problem of farm taxation, a preliminary study was undertaken along the following lines: (1) the farm tax burden compared to taxes of others than farmers, (2) trend in farm taxes over a period of years, (3) relation of farm taxes to farm income, (4) relation of assessed valuation to actual valuation of farm property, and (5) other information of interest and importance.

Much information on taxes collected in previous studies by the Department of Agricultural Economics and made available only in summary form will be incorporated in this study in detail. The material includes the analysis of farm business records for the principal types of farms in Maine. It includes the following types: dairy, poultry, apple, blueberry, and potato. Many interesting and important relationships are being found. In addition, detailed information was obtained last summer from town assessors' books regarding valuation and taxes on approximately 1,000 farms widely distributed throughout the State.

MARKETING OF MAINE APPLES. Merton S. Parsons. A study of certain phases of the marketing of Maine apples was started in 1928. The phases studied were: (1) market preferences

for apples, and (2) cull apples and their economic significance. The results are now going to press and will be available in Maine Agricultural Experiment Station Bulletin 359.

Information concerning market preferences for apples was obtained from retailers by means of personal interviews, and from consumers through the use of a questionnaire. The more important problems studied were as follows: varieties of apples preferred by retailers and consumers; counts, grades, and containers preferred by retailers; sources from which retailers and consumers obtained apples; consumers' knowledge of apples; qualities which consumers tried to obtain in buying apples; uses of apples by consumers; and the opinions of retailers and consumers regarding Maine apples.

The data for the study of cull apples were obtained by direct examination of culls and by interviews with apple producers. The principal considerations were: causes of cull apples on seven important varieties; control measures to lower the per cent of cull apples; and the economic significance of cull and inferior apples as shown by grading results, prices, and distributive costs of Maine apples.

The Dairy Industry in Maine. George F. Dow and Charles H. Merchant. The first section of this study has already been completed in manuscript form and will be published as Maine Agricultural Experiment Station Bulletin 361, "The Costs and Returns in Producing Milk, Raising Heifers, and Keeping Herd Bulls in Maine." This manuscript includes not only the itemized costs and returns for the dairy herd but also an analysis of many factors that affect the dairy income. Data used represent 178 dairy herds for the year ending March 31, 1928.

Of the total cost of producing milk, feed represented 52 per cent, labor doing chores 31 per cent, and other costs 17 per cent. The formula for the net cost of producing a hundredweight of milk was computed and was found to compare very favorably with costs in New York and Vermont. Although dairymen, on the whole, fed grain economically there were some who fed their herds inefficiently. The larger herds were found to utilize labor much more efficiently than did the smaller herds.

The average seasonal distribution of milk sold varied from an index number of 133 in June to 81 in October. Dairymen who had a uniform seasonal sale of milk had fewer cows freshening in the

months of February and March and had a greater proportion of their cows freshening during the four months from June to September inclusive. It was not necessary, on the average, to have more cows freshen in October, November, and December to obtain uniform sales of milk throughout the year.

A second phase of the dairy study, dealing with the production and utilizatoin of milk in Maine, is now being prepared in manuscript form. The information for this section was determined from questionnaires filled out by dairymen and from the records kept by dairy plants in Maine. During July and August, 1931, a total of 6,500 questionnaires was distributed to Maine dairymen through the cooperation of milk companies and creameries. Dairymen returned a total of 1,802 complete questionnaires, or 28 per cent of the total. These replies contained information concerning the size of herds, proportion of purebreds, breed of cows, additional cows that could be kept, amount of milk and cream sold per herd, and its butter-fat content. The differences between herds in each area of the State, and between the types of dairy plants are being analyzed.

Each of the larger dairy plants in Maine made available their records in order to show the total amount of milk and cream purchased from dairymen, average volume per producer, relative importance of cream, seasonal variation in the delivery of milk and cream, prices paid, and utilization of the milk and cream purchased. From these data are being determined the present status of dairying in each area of Maine and the total utilization of dairy products in the State. The analysis of this information is indicating many problems that the industry is facing, and relative advantages of each area in the State for the future development of dairying.

In addition to the data mentioned above the dairy plants and questionnaires from dairymen have supplied a great deal of information concerning the methods and cost of hauling milk and cream. These data will be analyzed and a study will be made of costs, methods of hauling, kinds of road, distance to haul, volume per trip, and other factors. This study is important as hauling costs represent a high proportion of the price received for milk and cream in the State.

THE POTATO INDUSTRY IN MAINE. Charles H. Merchant and William E. Schrumpf. The production phase of this study was

begun in 1929 to determine: (1) the status and trend of the Maine potato industry in regard to size of the potato enterprise, production methods, labor requirements, machinery requirements (especially tractors and trucks), the costs and returns on potatoes, and farm and labor incomes; and (2) the effect of the various factors of farm organization on farmers' income.

Information covering the production and disposal of the potato crops of 166 Aroostook County farmers has been obtained for the three years ending March 31, 1929, 1930, and 1931. Similar information has been obtained from thirty-eight producers for 1930 and 1931 in the potato producing area in central Maine. Three potato producing areas are represented, two in Aroostook County and one in central Maine.

Financial summaries of the farm business of each of the Aroostook County producers for three years, and for the central Maine producers for two years, are computed and averaged. These summaries include: (1) average capital in real estate, livestock, machinery, and feeds and supplies; (2) farm receipts from crops sold, increases in capital, livestock and livestock products sold, and miscellaneous sources; (3) farm expenses for labor, fertilizer, taxes, and all other farm expenditures; (4) farm income, obtained by subtracting farm expenses from farm receipts; and (5) labor income, computed by subtracting interest on average farm capital from farm income.

The business analyses of the Aroostook County farms for 1929, and of the Aroostook County and central Maine farms for 1930, are completed. Analyses for 1931 are partly computed. The business analysis considers labor income, size of farm, farm balance, production rates, use of labor, and distribution of capital.

The trends in the use of horses as compared with tractors and trucks as farm tractive power have been worked out, showing a decrease in the number of horses and an increase in the number of tractors and trucks. The increase in the number of dual purpose tractors is especially noticeable. The net relationships between yield per acre of potatoes and such factors as (1) green manure, (2) spraying, (3) barn manure, (4) commercial fertilizer, (5) quality of seed planted, and (6) quantity of seed planted per acre are being computed.

Other factors to be shown are: (1) the economical units of potato acreages for various combinations of men, teams, tractors, trucks, and other factors; (2) the influence of various methods of management on labor income; (3) the relative efficiency of different types of tractive power; (4) the importance of livestock in the organization of potato farms; and (5) the farm management methods resulting in low production costs.

QUALITY OF MAINE POTATOES. William E. Schrumpf. This study was conducted in cooperation with the Maine Development Commission and the Maine Department of Agriculture. The objects of the study are: (1) to determine the extent and causes of mechanical injuries to potatoes incurred by (a) digging, (b) picking into baskets, (c) emptying into barrels, (d) storing, (e) development in storage, (f) moving to graders, and (g) grading; (2) to show the relationships between the various handling practices and mechanical injuries. From the results of this study it is designed to suggest improvements in handling methods, intended to reduce mechanical injuries.

During the 1931 potato harvest in Aroostook County, in the vicinity of Caribou, Fort Fairfield, and Presque Isle, potatoes were examined in the field to determine the extent of the injuries caused by these various operations, as well as the relationship between the bruised and cut potatoes and various types of diggers, number and size of stones in field, amount of weediness, and several other factors.

In both farm and track storage houses samples were taken and the amount of bruised potatoes ascertained. These samples were left for an average of fifty-two days and examined again to note any development of bruised potatoes due to storage conditions.

Potato houses at rail sidings were visited while potatoes were being graded with mechanical graders. At these houses samples were obtained just before and just after grading to determine the amounts of potato injury caused by this operation.

ANIMAL BREEDING AND NUTRITION

INHERITANCE OF MILK PRODUCTION AND ASSOCIATED CHARACTERS IN CATTLE. John W. Gowen and W. Franklin Dove. The investigation of fertility has brought out some interesting facts.

The question may be asked, when shall an animal be considered sterile? In this study an analysis was made of the records of 7,679 cows which were bred one or more times and their subsequent history followed. Of those which subsequently dropped calves, or else were served again, 64 per cent of the total number served once became pregnant.

53 per cent became pregnant on the second service
49 " " " " " " third "
35 " " " " " " fourth "
35 " " " " " " fifth "
28 " " " " " " sixth "
18 " " " " " " seventh "
9 " " " " " " eighth "

The decreasing likelihood of a service resulting in a calf as the number of services necessary to success increases is made clear by these figures. If we consider that at least one service out of three should be successful to make the cow profitable to keep, then the cow which goes beyond five services should be sold.

The season of the year at which the service was made obviously played no part in its success. This fact is of interest since the changing seasons bring to the cows quite different foods, with different vitamins and other substances which are supposed to play a striking part in the success of the breeding. The figures for the percentage of the successful births are:

Month	Per cent of total services which resulted in pregnancy
January	58
February	59
March	56
April	57
May	62
June	59
July	67
August	64
September	55
October	58
November	61
December	61

The influence of age of the dam on the success of the service was much in accord with previous facts, save that the older cows bred more frequently than might have been expected. Thus 70 per cent of the services of under one year of age when bred were successful. The other percentages were:

Age of Dam	Per cent of total services which were successful
0 years	70
1	68
2	67
3	66
4	63
5	61
6	65
7	63
8	57
9	62
10	60
11	58
12	60
13	52
14	30
15	53
16	45
17	7

The data for the sires' ages showed similar results. There is evidently some decline in the fertility of the cow and the bull as their ages increase. This decline in fertility does not appear to end abruptly for there is still at least two-thirds the chance that the cow 16 years old will breed, provided of course that she has been a previous breeder, as compared with cows which are just beginning the reproductive cycle.

THE INFLUENCE OF ANTI-RACHITIC SUBSTANCES ON GROWTH IN POULTRY. W. Franklin Dove. During the past year 90 groups of chicks have been under observation in nutrition experiments. The principal aim is to determine what feeds, or feed combinations, will produce the greatest body gain in weight per unit of digestible nutrients consumed, i.e., to determine economy of production. A large number of experiments have been made in order to develop the technic by which we are able now

to detect slight deficiencies in proteins, fats, or minerals in the rations tested. Different rations vary widely in their ability to produce body gains. Some apparently normal rations require from four to six pounds of grain for each pound of body gain in weight, while others require only two and one-half to three pounds for the same increase. Simple increases in body weight are, of course, not the only criteria of an efficient ration. Some produce rapid and efficient increase in body weight, but produce a poor bone or deposits of fat.

To date we have confined our attention to proteins, and have been testing a protein feed which is excellent as a producer of rapid and economical growth in chicks. It is a by-product of the fishing industry and is prepared in Maine. The company which manufactures this feed is cooperating with us by supplying a product with detailed information on the ingredients and method of processing. This is important, as proteins of this type may be injured by improper methods of processing. One of the proteins contains large quantities of vitamin D. These tests are still incomplete, but it appears quite possible that we have here a natural source of vitamin D that may be of particular value to the poultryman.

The tests are being made on chicks up to 10 to 12 weeks of age (broiler age) and also on laying hens in order to determine the effect of the ration on fecundity and embryo mortality.

Similar nutritional tests are being made on the vitamin content of eggs and egg products. Recently, the tariff on imported dried egg products has been increased in order to stimulate the American business. Tests made last fall and still in progress indicate that eggs retain their high vitamin D content even though dried and stored for many months. As egg yolk is one of the few natural sources of vitamin D for human consumption it is important from the standpoint of both health and economics that it be biologically assayed and evaluated.

Both chicks and humans are highly susceptible to rickets, and both are cured of rickets by the same prophylactic measures. Test animals like the rat seem to require no appreciable amount of vitamin D when the correct mineral ration is supplied. The rat is able to live and reproduce for a number of generations on a ration that will sustain life in the chick for only a few months.

At this Station a colony of experimental white rats has been bred and reared through a number of generations (1927 to 1930) on a ration that kills chicks within 55 days and practically stops reproduction in mature birds within six weeks. Vitamin D added to this ration will produce normal growth in the chick and assure fecundity in mature birds. As the human reacts to lack of vitamin D more nearly like the chick than the rat, the chick should be favored as a test animal, especially in rating the vitamin D content of egg and poultry products intended for human consumption.

These tests are being made on fresh eggs from hens fed rations varying in vitamin D content in order to determine the ability of birds to store vitamin D in the eggs under different systems of feeding.

PHYSIOLOGY OF REPRODUCTION. *Embryonic Death.* For the past five years all eggs failing to hatch have been examined for possible causes of death. These data are now being analyzed statistically in order to determine the causative factors for the appearance of abnormal embryos.

The causative factors have been grouped under four headings:

1. Pathological. Specifically due to harmful bacteria within the egg.
2. Inherent. Defects or death due to gene combinations, especially through inbreeding.
3. Nutritional. Due to deficiencies in vitamins, proteins, or minerals in the laying ration.
4. Methods of handling, storage, and incubation.

Under these four headings we may be able to group a large proportion of the causes of failure to hatch.

From the various inbred strains of birds we have been able to isolate a number of defective types as apparently due to inbreeding. The effects of nutrition on embryo death, especially the lack of vitamins, are very striking and the effects of deficient proteins may also be detected in the dead-in-shell. Improper methods of storage, and variations in humidity and temperature during incubation, leave their mark on the chicks failing to hatch.

The position of the dead-in-shell has been observed to take many forms, some apparently preventing hatching. But other positions appear to be the result of a more deep-seated defective

embryogeny—the result of abnormal development and not in themselves the cause of failure to hatch.

Distinguishing the Sex of Birds. Each year since 1927 data have been taken whenever possible on separating the sexes of chicks by means of the presence or absence of the diminutive copulatory organ. By proper methods a high degree of efficiency in separating the sexes is attained. It is possible to obtain groups of male chicks at three days of age with 95 per cent accuracy. The female, however, causes most of the errors at older ages, especially around two weeks of age.

The method is even more accurate in distinguishing the sexes of day-old goslings and ducklings, both tame and wild.

A Modernized "Open Front" Poultry Plant. The "open front" type of poultry plant, originated and advocated in the past by the Maine Experiment Station, has been retained, in modern form, in the new experimental plant recently constructed. Not that the "open front" type of building is still the best means of controlling temperature and ventilation of a building—but rather that it is still, at times, the best means of promoting health and vigor of confined birds. Furthermore, its inclusion in the plans made it possible to combine a modern system of ventilation and heating with the best system of the past. In freakish weather, when almost any system of ventilator intakes and outlets work less effectively, it is possible to revert to the "open front." Likewise, during summer weather the "open front" alone may be the best.

The present plant has been constructed primarily for the housing of experimental birds but at the same time keeping in mind the possibility of carrying out experiments on ventilation and heating.

It is obvious to anyone seriously contemplating such a building that the "best" of the past cannot be immediately superseded until further information is obtained on many phases of the problem, not only on the effects of heat and various systems of ventilation and movement of air currents on the birds, but also on the effects of confinement and the possibility that a variable environment rather than a uniform environment may be more conducive to productivity.

In view of such facts the "open front" has been retained for use in case other systems fail or are found to be inadequate for the

best results. Combining this feature with intakes so that fresh air may be taken in either at the ceiling or at the floor makes it possible to "follow the weather."

FIG. 42. The New Poultry Laboratory at Orono is constructed "open front" or "closed front."

These questions arise: Are intakes needed in a building in a cold or windy location? Should not the fresh air be taken in near the ceiling during cold weather to prevent cold drafts on the floor, and at the floor in summer to keep rooms cool? Are uniform temperature and humidity as stimulating biologically as the variable environment? Is not sunlight still an efficient source of energy for metabolism, growth, and well-being of confined birds? In this new building these questions are obviously answered and the system

altered to suit the answer by constructing the plant to take care of many conditions of weather and requirements of the birds that might arise.

This system (or lack of system) has now been tested for two years on the general experimental flock. It has been found to be so successful in keeping birds healthy and the pens fresh and dry, that it seems quite possible that many of the difficulties encountered elsewhere are not the real difficulties previously supposed to exist, but that many of the problems may be effectively solved by a simple combination of the best of the past (open front) with correct insulation and vent-flues adaptable to changing weather.

Red Lights and the Prevention of Cannibalism. Through 1930 and 1931 cannibalism in battery reared birds has been immediately checked by darkening windows and diffusing the room with red from ruby colored electric lights.

Similar results were secured by covering windows with red paper, or by painting the window-lights, on the inside, with red paint or with a ruby stain. Red paper faded in sunlight within a few weeks, the ruby stain dried hard and chipped off, but the red paint has retained its color value and adhesive power for nine months with but slight indications of weakening. This suggests certain requirements in the red paint to be used, i.e.,, one with a mineral pigment which will not fade out rapidly when exposed to sunlight and the ultra-violet-rays, and an oil or oil-like base to prevent its chipping off.

In 1930, birds reared for their first 20 weeks of life under this system of red lighting have shown no marked deviations in growth or general size and appearance from those reared under ordinary lights or in sunlight, but tests carried out during 1931 indicate that light rays ranging in the color spectrum from red to blue have different effects upon the more fundamental biological processes of the organism, as, for example, on metabolism and sexual maturity.

Such far-reaching effects that deviations in light rays may have on growth and development are to be analyzed more closely in tests now under way.

PLANT BREEDING AND NUTRITION

FERTILIZERS FOR POTATOES. Joseph A. Chucka and Delmar B. Lovejoy. The fertilizer work on the permanent plots at Aroostook Farm has now been in progress for five years. By virtue of the fact that these plots receive the same treatment year after year they offer an excellent opportunity to study the residual effect of the various fertilizer treatments. The treatments used are furnishing information on such phases of potato fertilization as: fertilizer ratios, rates of application, sources of materials, high analysis fertilizers, maintaining or increasing organic matter content, and soil acidity. The last two years' data indicate that the average potato yields on the one-year rotation (continuous cropping with potatoes) are decreasing, those on the two-year rotation are increasing, while those on the three-year rotation are showing very little change. It appears that the different amounts of organic matter turned under on the various rotations are responsible for the yield trends. The potato tops on the two-year rotation, which has a green manuring crop turned under every second year, have remained green and have continued to grow a week to ten days after the potato tops on the one- and three-year rotations were all dead.

The use of varying amounts of magnesium in potato fertilizers was continued during the past season on three privately owned farms in Aroostook County. The results obtained again indicated that the so-called "potato sickness" of 1929 was nothing more than a magnesium deficiency and could be entirely prevented by adding magnesium to the soil. Although more experimental evidence is necessary before any definite conclusions may be arrived at as to the amount of magnesium necessary and as to the best source of this material, it appears on the basis of the results obtained, that approximately 20 pounds of magnesium oxide per acre gives the best results. Many Aroostook potato growers again observed magnesium deficiency in their fields which resulted in greatly reduced potato yields. As a result of our work on this problem a number of fertilizer companies are now offering for sale potato fertilizer containing about 20 pounds of magnesium oxide per ton of 4-8-7 or its equivalent. It was observed that the oats and clover grown on the plots where magnesium was used in

1930 had a much darker green color and were fully twice as tall as those grown on the plots which did not receive magnesium. This indicates that crops other than potatoes may suffer from a lack of magnesium on certain Aroostook soils.

The use of nitrate of potash in high-analysis potato fertilizers again gave very satisfactory results. On one farm the potato yields with the nitrate of potash mixtures varied from 120 to 137 barrels per acre while on the other they varied from 180 to 189 barrels per acre.

The substitution of rock phosphate or colloidal phosphate for superphosphate in potato fertilizers resulted in lowering the yield 20 to 30 barrels per acre on one farm and 54 to 58 barrels per acre on another farm. These results strongly indicate the necessity of having a soluble source of phosphorus in potato fertilizers.

The use of either ground or whole tobacco stems as a partial or sole source of potash in potato fertilizers gave fairly satisfactory results on the two farms where this was tried.

A comparison of 4-8-7, 4-8-10, and 4-8-14 formulas for potatoes was made on six different farms. On four out of the six farms 4-8-7 outyielded the 4-8-10 and the 4-8-14 gave the lowest yields in all cases.

CLOVER FAILURES IN A POTATO ROTATION. Joseph A. Chucka and Delmar B. Lovejoy. During 1929 varying amounts of ground limestone, marl, and hydrated lime were used on several farms in a study of clover failures. Clover yields were taken on these plots in 1930 and the results obtained indicated that invariably good clover stands could be obtained by the use of about 1,000 pounds of lime per acre.

During the past season these plots were in potatoes and, therefore, permitted a study of the effect of the various lime treatments on potato scab with lime treatments made two years before planting potatoes. As in previous years, an examination of the potatoes for scab indicated a wide variability from farm to farm in the effect of a given lime treatment on the amount of potato scab. In some cases practically no scab infection was observed even on the plots which received 4,000 pounds of lime per acre, while in other cases considerable scab was found where only 500 pounds of lime had been applied. Soil acidity tests were made on samples of soil from all of the plots examined and very

little correlation was found between the pH of these soils and the amount of scab infection. These results strongly indicate that liming is only one of several factors which determine the amount of potato scab. It seems highly desirable that a more exhaustive study of this problem be undertaken in the near future.

FIG. 43. Turning under a crop of clover at Aroostook Farm.

GREEN MANURING CROPS FOR POTATOES. Joseph A. Chucka and Delmar B. Lovejoy. A series of 128 plots was laid out at Aroostook Farm in 1931 for the purpose of studying the effect of various green manuring crops in two-, three-, and four-year potato rotations. The plots constituting the two-year rotation were seeded with grain and clover. Yields of the green manuring crops were taken on the two-year rotation and a sample of each of the crops was analyzed for nitrogen content. The results indicate that several of the crops used, namely, peas, vetch, crimson clover, mammoth clover, and mixtures of these with oats have possibilities as green manuring crops in potato rotations.

GRAIN VARIETIES AT AROOSTOOK FARM. Joseph A. Chucka and Delmar B. Lovejoy. *Oats.* During the past season Gopher oats has again outyielded Maine 340. Its high yielding ability together with its short, stiff straw and its early maturity make Gopher oats very desirable for Aroostook conditions.

Wheat. Garnet wheat outyielded the special strain of Red Fife recommended by the Station in the past. Like Gopher oats, Garnet wheat is an early maturing variety.

Barley. Of the three varieties of barley used in the comparative tests, Alpha barley gave the highest yield. Alpha barley, also, happens to be an early maturing variety.

Fertilizers for Sweet Corn and Beans. Joseph A. Chucka, Delmar B. Lovejoy, and Russell M. Bailey. A fertilizer and lime test on sweet corn and beans was started at Highmoor Farm in 1931. The experiment was planned to give us information regarding the proper kind and amount of fertilizer and the best method of its application. The various fertilizer applications were used alone, with lime, with manure, and with lime and manure. Although it is unwise to draw any conclusions from one year's results the data indicate very definite response to the lime treatments.

Fig. 44. Harvesting sweet corn on the fertilizer plots at Highmoor Farm.

Breeding New Varieties of Apples. Russell M. Bailey and Iva M. Burgess. The apple breeding work was continued during the past year. Fifty seedlings of the McIntosh x Northern Spy and McIntosh x Delicious crosses have produced their first fruits. These were budded into Tolman trees in the stock and scion orchard in 1925. Notes concerning the fruit quality and other char-

acters have been taken and these indicate that several are worthy of further testing.

FIG. 45. A Golden Delicious tree just coming into bearing.

Pollination studies involving the more important Maine varieties have been continued during the past season. Results obtained in 1931 corroborate those of previous years in that the irregular chromosome varieties like Greening, Gravenstein, and Baldwin are not suitable for interplanting and make but fair pollenizers for diploid varieties under most conditions. Wealthy, Delicious, Golden Delicious, McIntosh, and Spy all have high quality pollen and have given satisfactory fruit sets in hand pollinated crosses. Hand self-pollinations of the above mentioned varieties have resulted in a nearly complete failure to set fruit, thus emphasizing the importance of interplanting suitable varieties to insure good cross pollination.

BUD SELECTION IN THE APPLE. Russell M. Bailey and Iva M. Burgess. Observations made in the bud selection and in the stock and scion orchards indicate that a certain color variation exists in the McIntosh variety which is transmissible through the scion wood.

Fig. 46. One of the orchards at Highmoor Farm.

Canning Crops. Russell M. Bailey and Iva M. Burgess. Variety and strain tests of the more important canning crops in Maine, with particular emphasis on corn and beans, were conducted during the past season.

Tests were made of ten varieties of sweet corn, several hybrids and many inbred lines. Golden Gem, of the early varieties, responded well to our conditions this year and appears worthy of a place in the home garden. Of the usual canning varieties, none was found better adapted to Maine requirements than the Golden Bantam grown by Maine canners. However, some of the hybrids, resulting from preliminary single crosses made between inbred lines in 1930, surpassed all of the standard varieties in yield and uniformity; several appeared superior in quality at the time of harvest. Although one year's data are insufficient to recommend a particular cross, the superior response of several of these preliminary hybrids indicates that the use of hybrid sweet corn seed by Maine canners offers marked possibilities.

Garden Crops. Russell M. Bailey and Iva M. Burgess. This work has consisted of growing and studying, for their relative value under our conditions, varieties of tomatoes, beans, peas, cucumbers, squashes, melons, pumpkins, cole crops, root crops, pot herbs, lettuce, and peppers. Earliness, susceptibility to diseases, quality, and productiveness have been the principal characteristics noted.

Tomatoes. In connection with the variety testing some selection has been done among the tomatoes. Since two of the chief troubles with these fruits seemed to be irregular shape and cracks, these selections were made from individual plants showing better shaped fruits and fewer rain cracks than the average. A few of these, especially from Canadian and Red River, showed some improvement over the original variety.

Beans. The breeding work has been continued both for disease resistance and genetic studies. Last season conditions were very favorable for the development of diseases. There was a general infection by both blight and anthracnose. Some of the F_1 families showed differences in reaction to these. One of the F_3 families previously considered most promising from the standpoint of obtaining desirable snap beans, was completely destroyed. A healthy family, however, gave a few plants producing seeds similar to the Old Fashioned Yellow Eye.

In the dry bean strain test plot were eighteen lots each of Old Fashioned Yellow Eye and Red Kidney and four varieties of pea beans. There were at least three distinct types of Red Kidneys. The heaviest producer was not of the best commercial type of seed. None showed any distinct resistance to disease. Among the Yellow Eyes were strains of runner type and of bush type plants. The runner type produced the heaviest yield and also the best type of seed. Selections of the Highmoor strain produced the largest crops and also showed a possible resistance to blight. Two lots of bush type with seeds of a poor pattern type showed some resistance to anthracnose. These are being tested in the greenhouse for more definite evidence of their resistance. The pea beans were all healthy. Michigan Robust was the highest producer.

BLUEBERRY INVESTIGATIONS

FERTILIZERS. Frederick B. Chandler, Irvin C. Mason, and Joseph A. Chucka. The results with fertilizers indicated that an increase in yield may be obtained as great as three times that of the untreated plots. However, on most of the fertilizer plots a tremendous increase in weed growth also was obtained. Where competing plants grew high and produced an abundance of shade the blueberry crop was decreased. When the competing plants were

grasses the yield might be increased but harvesting was difficult and many berries were cut or broken by the grass.

Lime was applied to plots in varying amounts up to six tons per acre in an attempt to change the soil conditions so that phosphorus when applied would be more available to the plants. At the end of the first season the lime had not penetrated much more than an inch into the soil.

One year's results with magnesium indicate that it is not a limiting element or else that it is toxic in applications of 300 pounds per acre.

Selection and Variety Testing. Frederick B. Chandler and Irvin C. Mason. The Whitesbog varieties in the test plots were seriously injured by a disease appearing to be a magnesium or iron deficiency but the plants did not respond to the treatments with either or both of these elements. These varieties do not seem to be adapted to Maine. There is a demand, however, for a high-bush berry for the fresh fruit market and further tests are planned.

Propagation. Frederick B. Chandler and Irvin C. Mason. Root cuttings put in soil in cold frames during the spring of 1931 have produced many plants. This method of propagation is very simple and it is possible to produce from 100 to 200 plants from a square foot of blueberry sod. This method of propagation requires very little attention compared to propagation from stem cuttings.

Culture and Field Management. Frederick B. Chandler and Irvin C. Mason. Our sweet-fern plots have indicated that very good control of that weed may be obtained by cutting about the middle of June and the first part of September in the same year followed by a cutting in July or early August the next year, or by cutting three years in succession about the first of August.

Attempts are being made to kill the laurel by frequent burning or by the addition of nutrients for the blueberry which may be toxic to the laurel.

Experiments with different materials for burning and with different times of burning did not indicate any significant difference in the yield of fruit obtained from the plots burned with oil as compared with straw nor did this experiment show any advantage in an early spring burn over a late fall burn. The difference in yield of plots burned April 11, 1930, and May 16, 1930, was very small although the plants on the late burn made much less growth the first year.

CHEMISTRY

WORK OF INSPECTION. James M. Bartlett, C. Harry White, and Bernie E. Plummer. The Commissioner of Agriculture is the executive of the laws regulating the sale of fertilizers, feeds, foods and drugs, insecticides and fungicides, agricultural seeds, and dairy products. All samples for analysis are taken by him or his agents, but the law requires that the Maine Agricultural Experiment Station shall make the analyses and publish the results. In compliance with this law, for 1931 four bulletins have been published giving the results of our findings, namely,

Official Inspections 139—Foods and Drugs
" " 140—Feeding Stuffs
" " 141—Fertilizers
" " 142—Agricultural Seeds, Insecticides and Fungicides.

The milk and cream inspection is handled by the Division of Dairy Inspection. All samples are taken by the chief or his inspectors and sent to the Station for analysis. The samples are analyzed and reported to the Division of Dairy Inspection under the inspectors' number. The Station does not publish the results as it has no information in regard to the samples.

Gasolines and Oils. The legislature of 1929 enacted a law requiring that automobile gasoline and oil be inspected. The state auditor was made the executive of the law, but the adoption of the Code Bill by the legislature of 1931 transferred this office to the state tax assessor. The act requires that the analyses shall be made at the Maine Agricultural Experiment Station and the expense of the same shall be taken from the fund created by the gasoline tax. The executive or his agents collect all samples.

Gasoline. Since April 1, 1931, 429 samples of gasoline have been received and examined. The standard established by the Statute (96 per cent shall distill over below 437°F.) is very liberal; consequently all the samples passed and most of them by a large margin. A few samples were found to contain sediment and water, due probably to improper storing or handling. The gasolines of the different companies are now more nearly alike than they were a year ago, some of the lighter ones being a little heavier than formerly. Most of the so-called specials for high compression engines

are now made by adding ethyl lead to the regular gas. The ethyl gasoline is all colored red to distinguish it from the gasoline that contains no lead. A definite amount of color and ethyl lead is supposed to be added to all gasoline to entitle it to be called ethyl gasoline or no-nox; consequently all gasoline of that kind should have about the same depth of color. A few samples of gasoline labeled special or ethyl have been received that show much less color than the standard ethyl. As the regular gasoline sells for three cents a gallon less than the ethyl a dealer can readily increase his profits by adding some of the regular gasoline to his ethyl. This matter is being investigated.

Motor Oils. Although the motor oils have been very much improved and standardized there is still quite an amount of substitution being practiced. Out of the 450 samples collected and examined, 24 substitutions were found. In some cases the analysis indicated that the sample obtained was an entirely different oil from the one called for, as shown by the label. In most cases, however, the substitution appeared to be only a different grade from the one called for. Eleven samples were found to contain dirt or sediment and several of them some water.

Nearly all the large companies now are making dewaxed oils which have a low pour point and are much better for winter use.

WORK OF INVESTIGATION. *Experiments to determine the retentive powers of Aroostook potato soils for nitrogen.* Elmer R. Tobey. An equivalent amount of nitrogen from each of the following sources, ammonium sulfate, sodium nitrate, potassium nitrate, ammo-phos A, and urea was added to separate percolators, containing soil, and leached each week with a definite amount of water equivalent to one inch of rainfall. Twenty-four successive leachings were made. The amounts of ammoniacal and nitrate nitrogen in the leached extracts were determined. With the exception of the first few leachings in the case of the ammonia salts, the nitrogen recovered was all in the form of nitrate nitrogen. The extract from the first leaching of the ammonium sulfate contained 70 per cent of its nitrogen as ammoniacal nitrogen, that from the ammo-phos A 47 per cent of its nitrogen as ammoniacal nitrogen, and that from the urea 23 per cent of its nitrogen as ammoniacal and 47 per cent of its nitrogen as organic nitrogen. The amounts of ammoniacal nitrogen in the extracts from the ammonia salts and

urea rapidly decreased until none was found in the seventh leaching. The extract from the urea contained no organic nitrogen after the second leaching. This evidence indicates that the nitrogen from ammonium sulfate, ammo-phos A, and urea is rapidly converted in the soil to nitrate nitrogen.

The sodium nitrate was leached rapidly from the soil even at the first leaching. The largest amounts removed were at the fifth and sixth leachings, decreasing rapidly until the tenth leaching. At the thirteenth leaching an amount of nitrogen nearly as small as that from the control was obtained and this condition prevailed during the subsequent leachings.

In the case of potassium nitrate the results obtained were similar to those with sodium nitrate with the exception that the rate of extraction was a little slower at first, the largest amount being removed at the seventh leaching, with a rapid decrease in amount until at the thirteenth and subsequent leachings the amount of nitrogen removed was nearly as small as that of the control.

The amount of urea removed increased gradually up to the ninth leaching, with a slight drop in amount until the twelfth, followed by a rapid decrease until the level of the control was reached at the seventeenth leaching.

The results with ammo-phos A were very similar to those obtained in the case of urea with the exception that the rate of removal was slower, the maximum being reached at the twelfth leaching, followed by a rather gradual decrease to the control level at the twenty-second leaching.

The nitrogen applied in the form of ammonium sulfate was retained in the soil much better than that in any of the other forms. A gradual increase in the amount removed occurred up to the ninth leaching, and then it remained fairly constant up to the thirteenth, with a gradual decrease until the end of the experiment. At no time did the amount decrease to the control level.

After making a correction for the control, the total amount of nitrogen removed by the leaching effect of the water (equivalent to 24 inches of rainfall) is equal to the following percentages of the amount of nitrogen added in the form of the salts.

Ammonium sulfate	60.19 per cent
Sodium nitrate	88.58 " "
Potassium nitrate	86.58 " "
Ammo-phos A	78.58 " "
Urea	82.12 " "

ENTOMOLOGY

BLUEBERRY INSECTS. Clarence R. Phipps. Station Bulletin 356 contains all our previously unpublished information concerning insects affecting blueberry and huckleberry plants. In all, nearly 300 different species of insects are listed, of which over 80 species are newly recorded as destructive to these plants. In most cases considerable information is given covering the life history, habits, and control of the injurious forms.

During the season of 1931, additional species of beetles were found feeding upon the swelling blueberry buds. One species, *Serica sericea*, was reported in great numbers on strawberry, birch, and alder in Maine in 1905. Another beetle, *Dichelonycha testacea*, attacked high-bush blueberry plants in North Sedgwick during the summer of 1931.

BLUEBERRY POLLINATION. Clarence R. Phipps, Frederick B. Chandler, and Irvin C. Mason. Our 1931 studies corroborated previous observations that insects are necessary in the pollination of the blueberry. The results obtained in cage experiments with honeybees were interesting. A hive of honeybees was confined in a cage containing parts of two distinct clons of the sour-top blueberry, *Vaccinium canadense*. The plants in this cage produced an unusually large number of berries as compared with those plants of the same clon outside the cage. A second cage from which, in so far as possible, insects were excluded, yielded a crop of only one berry.

CUTWORMS. Clarence R. Phipps and John H. Hawkins. During the fall of 1931 the corn earworm was extremely abundant in this State. It constituted the first conspicuous outbreak of this pest in Maine in nearly ten years.

The morphological and taxonomic studies of cutworm larvae and pupae are being continued, as are also our investigations of various types of light traps for use in the capture of the adult moths. The latter study includes the use of colored glass screens and of bulbs of varied intensities and qualities including ultraviolet. Several thousand insects were caught in these traps in 1931, including over 100 species of cutworm moths.

WIREWORMS. John H. Hawkins. The two most common species in Maine, the wheat wireworm and the upland species, are

best controlled by crop rotation in which clean culture is practiced. The results of our experimental work during the past several years support this conclusion which is in line with the findings of other investigators. This rotation should be short and should not include timothy. If a hay crop must be grown, clover is recommended. After three years of clean cultivation the wireworm population will ordinarily be reduced to such an extent that these insects are no longer an important factor.

APPLE FRUIT FLY OR RAILROAD WORM. Clarence R. Phipps. The control of this insect has become a serious matter in Maine. In fact a special campaign is now being undertaken by the several New England States in an effort to eliminate the neglected apple tree since it serves as a center from which this and other fruit pests may disseminate.

Dispersal. Since growers and investigators alike have reported difficulty in controlling the apple fruit fly in orchards located in the vicinity of unsprayed apple trees, it is important to know how far this influence may extend. Experiments conducted by this Station during the summer of 1931 yielded definite experimental information bearing upon this important question. In all 1,035 flies were marked and released, the object being to recapture as many of them as possible later on and to thus gain some idea concerning their flight habits. Of this number, 123 individuals were subsequently recaptured at varying distances from the release point. This number constituted about 12 per cent of the total number marked and thus the data are quite significant. The following table presents a summary of these results:

RECOVERY RECORDS GROUPED ACCORDING TO DISTANCE

Distance	Total No. Flies	Per Cent of Total Recovery
38 to 73 yards	33	26.8
75 to 95 yards	70	56.9
98 to 156 yards	20	16.2

From the results obtained in 1931 the following conclusions are drawn:

A. Apple fruit flies will readily travel 150 yards or more in search of desirable fruits. The 1931 experimental area contained so many attractive bearing apple trees within a radius of 150 yards

of the release point that there was probably little incentive for the flies to disperse greater distances.

B. Dispersal is often a gradual process and is governed in part by season changes in varietal preference.

C. Neglected apple trees within 200 yards of commercial plantings should be sprayed or cut down.

Life History Studies. By means of emergence cages located in various parts of the State, the life history of the insect is being further investigated. The *time* of fly emergence, upon which our spraying program is based, is found to vary with the variety of apple in which larval development takes place. It also varies with the locality and soil type concerned. The *extent* of emergence is also governed by the same factors, at least in part. During the past season over 100,000 larvae were collected in traps (see Fig. 47) in two localities alone. These individuals will furnish extensive mortality and emergence records for those localities during the summer of 1932.

FIG. 47. Double-decker traps used in concentrating large numbers of larvae from different varieties of infested fruit. In foreground, soil boxes for over-wintering pupae.

A. Time of fly emergence. In 1931 the flies from such varieties as Red Astrachan began to appear about a week earlier than those from McIntosh and all later sorts. The influence of locality and soil type is illustrated by the fact that the first flies from Red Astrachan apples in Cumberland Center appeared on June 19 whereas flies from the same variety at Highmoor Farm did not appear until July 5.

B. Extent of fly emergence by variety. Only a very limited number of flies are able to develop in late variety apples. It is therefore safe to assume that practically all of the carry over from one season to the next must be charged to such early varieties as Red Astrachan, Williams, Early Harvest, Sweet Bough, Wealthy, etc.

C. Duration of pupal stage. The majority of these insects spend one winter in the pupal stage. Our studies have shown that in Maine some of the pupae spend two winters in the ground. They constitute the so-called two-year cycle in which the flies do not emerge until the second summer. On the other hand, certain individuals spend an unusually short period in this stage; indeed, a limited number of flies emerge in the fall after spending only a few weeks in the pupal stage.

Control Studies. These studies include the use of various insecticides and arsenical substitutes. In cooperation with the Extension Service and the State Department of Agriculture a program of neglected tree removal is being undertaken. Likewise the collection and destruction of drop apples is still being advocated since larvae which would otherwise develop and leave the fruits may thus be destroyed.

INSECTS IN RELATION TO VIRUS DISEASES OF POTATOES. Geddes W. Simpson and Donald Folsom. During the summer of 1931 seven seed plots were established in five sections of Aroostook County. The seed used in these plots was obtained from various Canadian sources relatively free from disease. The plots were periodically rogued for disease throughout the summer. Some plots were found to be much more nearly free from disease than others thus revealing some of the better sources of Canadian seed.

Since it is known that aphids play an important rôle in the spread of virus diseases, counts were made relative to their abundance.

At digging time tubers were selected at varying distances from hills which had been removed because of disease. Some of these tubers were subsequently indexed in the greenhouse during the winter and the rest will be grown at Aroostook Farm this coming summer.

In addition to the indexing studies, tubers were selected at random from each of the seed plots and grown in the greenhouse. One hundred tubers were thus collected from each plot. The results of this work furnish each grower concerned with some idea as to the amount of disease which he may expect his seed plot to exhibit during the coming season. While it is not, of course, an exact measure of future conditions, it is believed to be a fair indication. All tubers so indexed become the property of the Experiment Station and will be used in experimental work the following season as a foundation source of seed of known history and approximately known degree of freedom from disease. The winter indexing work is thus made to serve both the grower and the investigator.

APHIDS. Edith M. Patch. The economic significance of aphids has been increasingly appreciated during recent years since many species of this family of insects have been found to be carriers of plant diseases.

To those who are concerned with plant diseases, therefore, as well as to those who are concerned with direct damage by aphids, it is important to know all the species of plants which are susceptible to attack by a given species of aphid.

In this connection a catalog of the food-plants of the aphids of the world is in preparation.

HOME ECONOMICS

ELECTRICAL COOKERY. Pearl S. Greene and Lolie Smith. The work in the electrical cookery project has been devoted largely to a study of the relative efficiencies of different types of utensils. In a comparison of utensils of different materials (stainless steel, wrought aluminum, cast aluminum, green enamel, and white enamel), but of similar size, time for heating a given volume of water to boiling on the same open type burner varied from 11′ 33″ for green enamel to 13′ 25″ for cast aluminum and on a closed type

burner from 13′ 2″ for stainless steel to 18′ 18″ for green enamel. These differences represent a variation of 13 per cent in cost on the open type burner and 25 per cent in cost on the closed type burner.

When green enamel, white enamel, brown earthen, pyrex and stainless steel utensils containing uniform amounts of string beans and water were heated in an oven, the range in time to bring the material to the boiling point varied from 21′ 5″ for white enamel to 40′ 30″ for stainless steel.

When tin, aluminum and Russian iron baking sheets were used for baking biscuits, to secure uniform volume and browning it was necessary to preheat the oven to 275 degrees C. for the aluminum and tin, while 250 degrees was adequate for the Russian iron. The difference in temperature necessary represented a difference in cost of 16 per cent for electricity.

Problems of oven and burner management and the choice of cooking processes were also investigated.

In a comparison of burners of different sizes, wattages, and types of construction, electrical consumption in heating and cooking string beans uniformly in the same covered pan varied so that the maximum cost was 17 times the minimum.

The amount of water used in boiling and steaming vegetables is found, also, to cause much variation in fuel costs. Many of the present methods of typical Maine practice need to be revised to secure economy when electricity is used for cooking.

THE COOKING QUALITY OF POTATOES. Marion D. Sweetman. The work on this project for the past year has been largely confined to a study of factors affecting, or correlated with, mealiness. Forty-five lots of potatoes grown in Maine and New York including 15 to 20 varieties have been tested for mealiness, both when boiled and when baked, for amount of starch, size of starch grains, viscosity of starch, increase in volume of starch during heating, content of soluble pectin and protopectin, and amount of sloughing when boiled. No one of these factors is correlated completely with mealiness, but it is hoped that it may be possible to locate the combination of factors which will explain the lack of mealiness in certain tubers of relatively high starch content.

In a comparison of healthy Green Mountains with diseased stock including rugose mosaic, mild mosaic, leafroll, and spindle

tuber no outstanding differences in mealiness were noted, but the healthy had the largest percentage of starch, 17.7, mild mosaic and leafroll had 17.1 per cent, spindle tuber 16.4 per cent, and rugose mosaic the least, 16.2 per cent.

This department is cooperating with the United States Bureau of Agricultural Engineering to the extent of carrying out a series of cooking tests on potatoes being held in a number of experimental storage cellars in Aroostook County. The results are verifying our previous work in showing that storage temperatures below 45 degrees F. cause undesirable accumulations of sugar.

PLANT PATHOLOGY

POTATO DEGENERATION DISEASES. (In cooperation with E. S. Schultz, W. P. Raleigh, and C. F. Clark, of the Division of Horticultural Crops and Diseases, United States Department of Agriculture.)

Effect of Roguing on the Amount of Disease and on the Yield, in Northeastern Maine. Reiner Bonde, E. S. Schultz, and W. P. Raleigh. In Aroostook County, Green Mountain seed stock that had been rogued in an isolated tuber-unit seed-plot during each of the past several seasons, had mosaic in 3 per cent of the hills in 1931 and yielded at the rate of 183 barrels (503 bushels) per acre. This stock was compared with parts of the same original stock that had been left unrogued for different lengths of time. Stock only one year unrogued had mosaic in 20 per cent and yielded 181 barrels (498 bushels) per acre. Stocks two and three years unrogued yielded respectively 159 and 122 barrels (437 and 336 bushels), and were 98 and 100 per cent mosaic respectively. The most of any other virus disease found was 12 per cent spindle tuber in the stock unrogued for three years. These results show that proper roguing can greatly reduce the natural increase of mosaic, that it is not necessary to secure new seed stock every year for table-stock fields, and that mosaic may reduce the yield considerably if allowed to increase to a high percentage. A two-man planting machine can be used satisfactorily for planting tuber-unit seed plots. It is necessary to rogue at least four times during each season.

The Green Mountain stock referred to in the preceding paragraph was obtained in 1922 and had been rogued annually in a seed plot of from one to two acres. On other seed plots, similar except for being smaller, Green Mountains, Irish Cobblers, Bliss Triumphs, and two seedling varieties of Green Mountain parentage, have all been maintained free or nearly free of disease for several years. In 1930, roguing decreased mosaic in three plots out of four, and three healthy stocks remained healthy in clearings in the woods at a distance of 500 feet or more from diseased potatoes.

Natural and Experimental Transmission in Green Mountains in Central Maine. Donald Folsom. In central Maine, in 1930, leafroll spread in Green Mountains from tuber units before they were rogued on June 24. When rogued, the plants were only a few inches high, but aphids were already present. Such spreading of leafroll was much less important, however, than the spreading of the disease from tuber units that were not rogued out. The dissemination of the disease from unrogued plants occurred later in the season, when wingless aphids were abundant, and was mostly limited to a distance of one to three feet. Flea beetles were abundant early in the season, with no corresponding dissemination of leafroll. Spindle tuber appeared to a slight extent in a tuber line which during the preceding year was healthy and was grown several hundred feet from spindle-tuber stock. Five tuber lines that had been grown more than 1,500 feet from the nearest diseased potatoes remained healthy.

Potato aphids (*Macrosiphum solanifolii*) in field insect cages transmitted leafroll to young plants but not to older ones. To plants of the same age, 500 of these aphids transmitted the disease while 300 did not. Such aphids taken from plants affected by leafroll and mosaic together, transmitted these diseases both separately and together, and transmitted more leafroll than mosaic. In three of the field cages, negative results were obtained with leafroll from the transfer of tarnished plant bugs (*Lygus pratensis*), in two cages, from the transfer of flea beetles (*Epitrix cucumeris*); and in 21, from contact with foliage and roots of diseased plants.

Experimental Transmission by Insects in Northeastern Maine. E. S. Schultz, Reiner Bonde, and W. P. Raleigh. A comparison was made of the aphids *Myzus persicae, Aphis abbreviata,* and *Macrosiphum solanifolii* regarding their relative efficiency in trans-

mitting mosaic, leafroll, and spindle tuber. In 1930, approximately the same number (200 per cage) of each of the three species of aphids were placed on mosaic, leafroll, and spindle tuber potato plants from which they were allowed to disperse to healthy potato plants (var. Triumph) propagated under muslin covered cages. Observations on the second generation of these aphid infested potatoes, in 1931 disclosed that the three species of aphids transmitted mild mosaic and that *M. solanifolii* had transmitted this disease to a lower percentage of inoculated plants than the other two species. *M. persicae* transmitted leafroll to every infested plant while the other two species failed to transmit this disease. The plants infested with *A. abbreviata* were colonized so heavily that the tops may have been killed before the virus reached the tubers which may account for the negative results obtained with this species. Furthermore, *M. persicae* was the only species that transmitted spindle tuber in this test. This species apparently is more effective than the other two species in transmitting these three diseases.

M. solanifolii failed to transmit the latent virus to a potato seedling which is susceptible to this disease and manifests it in the form of a necrosis. This confirms field observations indicating that certain aphids apparently do not spread this latent mosaic.

The flea beetle, *Epitrix cucumeris,* and the potato beetle, *Leptinotarsa decemlineata,* transmitted spindle tuber about as effectively as *M. persicae,* while the tarnished plant bug, *Lygus pratensis,* failed to transmit spindle tuber. The flea beetle also was used in transmission tests of mild mosaic and leafroll. In these tests this insect failed to transmit either disease. These results substantiate in part previous experience indicating that aphids are the most effective vectors of mosaic and leafroll of potato.

Detection in Dormant Tubers. Donald Folsom. In central Maine, in 1930, healthy plants were grown near leafroll plants and contracted the disease but without its becoming apparent until the second generation was grown in 1931. Identification in the dormant tuber during the winter of 1930-31 was attempted in several ways, as follows: (1) loss in weight by the tubers from digging time to different dates including planting time, (2) resistance to alternating current, (3) generation of direct current, (4) resistance to a fruit-maturity pressure tester, (5) refraction of light by soluble solids in the juice, (6) degree of acidity of the juice.

Even where there were average differences apparently due to disease, the individual variation in tubers of each lot made it impossible to segregate diseased tubers. No practical results were obtained by applying the same tests to stocks containing spindle tuber, mild mosaic, and rugose mosaic.

Breeding for Immunity. E. S. Schultz, C. F. Clark, Remer Bonde, and W. P. Raleigh. The Irish Cobbler and Spaulding Rose (Rose 4) varieties are immune to mild mosaic and respond well to good seed-plot practice. In the production of Green Mountains, however, a principal limiting factor is mild mosaic. Resistance and immunity to this disease are shown by some of the many new seedling varieties that have been tested. No new variety has been found resistant to spindle tuber or leafroll. In one new variety, named the Katahdin, leafroll and spindle tuber have been found to reduce the yield about 50 per cent.

ROTS OF POTATO TUBERS AND SEED PIECES. Reiner Bonde. In confirmation of the results of previous seasons' studies in Aroostook County, the blackleg organism can be isolated readily from both powdery-scab and common-scab lesions. Bacterial infection from such sources serves sometimes as a source of inoculum to produce rot lesions on the cut seed-pieces. Such infected seed becomes infested by certain maggots and produces blackleg plants. Maggots may also attack seed-pieces injured by fertilizer in the field and thus induce seed-piece rotting and blackleg. The greatest amount of control results from planting soon after cutting the seed. In laboratory cultures, the maggots required organisms in addition to the one causing blackleg, in order to develop to the pupal stage.

A new kind of soft, watery rot was found in as high as 30 per cent of the tubers in one place at digging. A Pythium-like fungus was isolated and used effectively to produce a similar rot.

POTATO SPRAYING AND DUSTING. Reiner Bonde. These data apply only to the Green Mountain variety in Aroostook County.

Field Survey. A field survey made during the last week of August, 1931, showed that in 62 per cent of 940 commercial fields, 80 per cent or more of the vines were dead. Judging from these data and from the yields of experimental plots, the loss from premature death of the vines was between 7 and 10 per cent of the crop in the one variety. The causes of this loss were the prevalence of

the late blight disease or "rust" (*Phytophthora infestans*) and the ineffectiveness of the control methods of most of the growers. This ineffectiveness was due chiefly to a discontinuance of spraying or dusting too early in the season.

FIG. 48. Spraying potatoes on Aroostook Farm with an 8-row rig.

Effect of Last Spray Applications of the Season. In one series of experimental plots, the yield per acre was 151 barrels with the regular spray schedule followed, was 120 barrels with no spraying done, and was 119 barrels with the last spray applications of the season omitted and with late blight consequently becoming severe. The omission of the first three of the nine regular applications did not change the yield of 151 barrels.

In another series of plots, the omission of the first three of the nine regular applications was associated with a yield of 151 barrels while the yield with the regular schedule followed was 148 barrels.

In a third series of plots, the tubers were dug at different dates. Up to August 24 there was no difference between sprayed and non-sprayed plots. After that time, with the development of late blight, there was a progressive increase in yield in the sprayed plots but no further yield increase in the nonsprayed.

Comparisons of Different Kinds of Machines and Materials. Copper-lime dust did not control late blight as well as Bordeaux

mixture did, both being applied with wheel-traction machines, and the yields per acre were respectively 139 and 151 barrels. Corresponding averages for eight years' comparisons are 130 and 133 barrels against a yield of 123 barrels for nonsprayed check plots.

Bordeaux mixture applied with a wheel-traction sprayer controlled late blight practically as well as where applied with a tractor-power sprayer, and the yields per acre were respectively 151 and 159 barrels. Yield loss through mechanical injury was greater in some rows with the power sprayer than with the wheel-traction machine, but with the former there were more uninjured rows, due to the greater length of boom, and consequently there was less loss per acre.

Similar blight control and yields were obtained with several kinds of spray mixture when applied with the tractor-power machine. These mixtures were standard Bordeaux mixture, "instant Bordeaux" mixture, Burgundy ("sal-soda Bordeaux") mixture, and Oxo Bordeaux, a commercial preparation containing much less copper than the others in the amount applied per acre.

Copper-lime dust applied at the rate of 200 pounds per acre during the season, did not control late blight as well in the early part of the season as did such dust applied at the rate of 280 pounds. Neither, however, prevented injury by late blight and the yield rates were the same with the two treatments. With the dust applied at the same rate, certain plots were dusted when the foliage was dry and others when the leaves were wet with dew. The difference in amount of disease was slight and apparently not enough to cause any significant difference in yield.

Bordeaux mixture made with stone lime controlled late blight just as well as that made with hydrated lime and the yields were essentially the same.

The sixteen-year average, for 1916 to 1931, of Bordeaux-sprayed plots shows a gain of 30 bushels or 11 barrels over the nonsprayed check-plot yield of 328 bushels or 119 barrels. In most years the Bordeaux was applied with a wheel-traction machine.

Spray Service. A potato spray service was started in 1931 under the direction of the local Farm Bureau. Through this service farmers received timely spray warnings and information regarding the general disease situation in the County. They also

received notices regarding the dates on which it was intended to spray on Aroostook Farm. Reports from growers receiving the spray service indicated that their methods had been improved as a result and this was confirmed by observation of their fields. The spray service was found to supply a need.

Varietal Resistance in Place of Spraying. A variety known locally as "Rust Proof", when not sprayed, was not appreciably affected by the prevalent and very serious late-blight epidemic. The foliage and the tubers were remarkably resistant to artificial inoculations with the fungus. In low, moist places where rot was serious in Green Mountains the Rust Proof did not decay; in fact it yielded 32 barrels per acre more than Green Mountains. On high, well-drained soil, the yield of the two varieties was about the same. The Rust Proof variety although resistant to rust is not suitable for general commercial growing in Aroostook County because of its extreme lateness. It is, however, valuable for further breeding studies.

Potato Seed Treatment. E. S. Schultz and W. P. Raleigh. (Of the Division of Horticultural Crops and Diseases, United States Department of Agriculture, cooperating.) In the seed potato treatment experiments at Presque Isle, Maine, in 1931, the standard treatments, corrosive sublimate, hot formaldehyde, and cold formaldehyde, were compared with the new organic mercury dips, Sanoseed and New Improved Semesan Bel, and with short time dips of formaldehyde, yellow oxide of mercury, corrosive sublimate, and mixtures of corrosive sublimate and acid, corrosive sublimate and potassium iodide, and corrosive sublimate and ammonium carbonate.

Three lots of seed potatoes were used in these experiments, namely, Rhizoctonia-infected Irish Cobblers, apparently Rhizoctonia-free Irish Cobblers, and field-run Green Mountains that showed a low percentage of Rhizoctonia-infected tubers. The Rhizoctonia-infected Irish Cobblers were used to get an index of the efficiency of the treatment used. The apparently clean Irish Cobblers were used as a check on any injurious effect of the treatment, while the field-run Green Mountains were used to get an idea of the benefit of treating what might be considered average seed.

The results in 1931 were similar to those obtained in previous years in that significant increases in yield were obtained in practi-

cally all cases where Rhizoctonia-infected seed was used but where clean seed or seed with a low percentage of Rhizoctonia-infected tubers was used the differences probably were not significant.

The commercial organic mercury dips compared favorably with the standard treatments both in yield and in control of Rhizoctonia.

Some of the short-time corrosive sublimate treatments showed promise and it is planned to place more emphasis on these and other short-time treatments in future experiments.

POTATO SCAB. W. P. Raleigh. (Of the Division of Horticultural Crops and Diseases, United States Department of Agriculture, cooperating.) Certain russet varieties and some seedling varieties were found to be resistant to scab on land where Green Mountain tubers were too scabby to be salable.

APPLE SCAB CONTROL. Donald Folsom. In 1931 a study was made of the effects, on bearing McIntosh apple trees, of a dry lime-sulphur spraying program and of modifying this program in one series by adding iron sulphate and in another series by replacing lime sulphur with calcium monosulphide after blossoming.

FIG. 49. Apples on a McIntosh tree receiving no treatment for control of scab.

Lime sulphur reduced scab, from the 100 per cent obtained on the fruits of untreated checks, to 20 per cent. This amount of uncontrolled scab resulted from leaf infection which started during blossoming and was aggravated by the absence of a six-weeks' application in middle July. The addition of iron sulphate had no significant effects on leaves or fruits. The substitution of calcium monosulphide resulted in an increase of fruit scab to 71 per cent following a significant increase in leaf scab. In trees sprayed with lime sulphur, fruit scab was not increased by proximity to unsprayed trees which had about 50 per cent of their leaves infected. Yield of fruit was reduced by scab about 65 per cent in the checks. Correlation studies with individual tree records showed that there were: more leaf scab with less leaf injury; more fruit scab with more leaf scab; greater fruit yield with more leaf injury and with less leaf scab. A continuation of a study of trunk girth showed high and significant correlation between yield and total girth, among sprayed trees, but not between girth increase of the current year and leaf scab or leaf injury of either the current or preceding seasons.

FIG. 50. Apples on a well-sprayed McIntosh tree at Highmoor Farm.

In 1931 the orchard of small McIntosh trees set out in the spring of 1928 was used for a continuance of the study of the effects on such trees of different spray and dust treatments with respect to scab, leaf burning, and growth. The results on about 350 trees are as follows:

Treatment	Percentage of leaves		Diameter
	Scabby	Burned	increase, mm.
Sulphur dust (Kolo-types)	13	16	10.8
Sulphur dry mix (Koloform)	20	18	10.8
Dry lime sulphur	11	37	10.2
Lead arsenate	24	40	10.1
Nothing	40	18	9.3

These figures indicate that growth, as expressed in diameter increase, was greatest with the two treatments giving the least burning and was least with absence of treatment which was followed by the most leaf scab. However, the differences were not statistically significant except where absence of treatment was concerned. In individual trees there was a high correlation ($+.702 \pm .018$) between the diameter increase of the current year and that of the preceding year. Also there were significant differences between trees in one soil type and those in another, with the treatment the same. Therefore the orchard environment of the individual tree appears to have exerted a greater effect upon growth than the kind of spray or dust treatment.

BLUEBERRY DISEASES. Florence L. Markin. *Witches' Broom.* Witches' broom (*Calyptospora columnaris* Kühn) by 1931 had affected 76 per cent of the high-bush blueberry bushes (*Vaccinium corymbosum* L.) set out in a nursery in 1928, but only four per cent of the low-bush plants (*V. canadense* Kalm. and *V. pennsylvanicum* Lam.) set out at about the same time in the same nursery. In the vicinity, 59 per cent of the wild high-bush plants but only a trace of the wild low-bush plants showed the disease. This malady dwarfs plants and makes them barren. In the nursery, the yield of certain low-bush plants with brooms was 43 per cent less on the average than the yield of corresponding plants without brooms. (These are hybrid *V. pennsylvanicum* plants belonging to the United States Department of Agriculture and picked by courtesy of F. V. Coville of the Division of Botany of that Department.)

Since witches' broom is perennial in blueberry, several means of eradicating the disease from infected plants were tried. Some high-bush plants with recent infections had all of the brooms removed in 1930. Over half of the pruned plants remained free of brooms during the following year. Fuel oil and other weed killers were found to be very effective in destroying low-bush plants affected with brooms. Because fir (*Abies balsamea* (L.) Mill.) in Maine is known to be an alternate host of this disease, and because as a consequence the disease is much more abundant near firs, such trees have been removed from the vicinity of certain blueberry fields. It is as yet too soon to determine the results of this eradication of fir.

Other diseases. Three foliage diseases were outstandingly important in 1931. These were a brown leaf-spot, leaf rust (*Pucciniastrum myrtilli* Arth.) and mildew (*Microsphaera alni* var. *vaccinii* (S.) Sal.).

The brown leaf-spot was sparse in eastern Maine, but was widespread and very destructive in some areas in central and southern sections of the State on low-bush blueberries.

Leaf rust and mildew were common on both huckleberries (*Gaylussacia* spp.) and blueberries; the former was the more abundant and important of the two diseases. There was practically a hundred per cent infection of leaf rust on *V. pennsylvanicum* from Calais to Franklin in Washington County during the latter part of August. Defoliation commenced early in July in regions where leaf rust and mildew were prevalent and almost all the leaves of plants growing in heavily infected areas had fallen by picking time. Berries on defoliated plants, instead of ripening, became shrunken and dropped off. The results of fungicidal treatment of plants in heavily infested areas are discussed below.

The so-called red leaf-spot disease (*Exobasidium vaccinii* (Fckl.) Wor.) increased somewhat in 1931, but so far seems to be of little economic importance.

Twig blight (*Sclerotinia sp.*) is a serious disease during some seasons. Sclerotinia also causes a hard rot of the fruits. This disease was prevalent in 1929, but sparse in 1930 and 1931.

This past season, several new diseases of blueberries have been observed, especially on twigs and stems. One of these occurred throughout one high-bush planting. The plants were in a weakened and dying condition and of no value to the owner.

Some fields showed injury from calcium arsenate dust which had been applied to control the blueberry fruit fly. Injury was often found in fields having heavy infections of foliage diseases, but the latter are not believed to have been the primary factors responsible for the burning.

Effects of fungicides. Blueberry plants responded well to certain fungicidal treatments in an area where foliage diseases, particularly leaf rust and mildew, were abundant. With copper-lime dusts there were increases in yield, over the untreated checks, in amount from 200 to well over 320 per cent. The increase with lime sulphur was over 50 per cent and with Bordeaux mixture somewhat more. Where there was a light infection of foliage diseases, the copper-lime dusts increased the yield from 25 to 40 per cent while there was little change in yield with lime sulphur and Bordeaux mixture.

Although Bordeaux mixture gave good fungicidal control, it was found to be injurious to blueberry plants in all of six tested combinations of copper sulphate and lime. It increased the yields only where there were heavy infections; otherwise the detrimental effects from the fungicide were great enough to offset any benefits derived from disease control. On some plots, Bordeaux mixture even stunted the plants to the extent that there was a reduction in yield.

Bordeaux mixture controlled sclerotinia twig blight. It and the copper-lime dusts prevented arsenical burning of leaves.

The use of protective fungicides resulted in cleaner foliage and greater number of leaves (that is, retention of leaves until late into the fall). Studies showed that the yield and the number of fruit buds were directly related to the number of leaves per stem. Furthermore, the size and number of berries per stem were favorably influenced by increased foliage.

ANNOUNCEMENTS

ESTABLISHMENT OF THE STATION

The Maine Fertilizer Control and Agricultural Experiment Station, established by Act of the Legislature approved March 3, 1885, began its work in April of that year in quarters furnished by the College. After the Station had existed for two years, Congress passed what is known as the Hatch Act, establishing an agricultural experiment station in every state. This grant was accepted by the Maine Legislature by an Act approved March 16, 1887, which established the Maine Agricultural Experiment Station as a department of the University. The reorganization was effected in June, 1887, but work was not begun until February 16, 1888. In 1906, Congress passed the Adams Act for the further endowment of the stations established under the Hatch Act. The Purnell Act, passed in 1925, has materially increased the Federal support of the experiment stations in the several states and broadened the scope of their activities.

The purpose of the experiment stations is defined in the Act of Congress establishing them as follows:

"It shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the Physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantage of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manure, natural and artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective states or territories."

The work that the Experiment Station can do under the Adams Act fund is more restricted. This fund can "be applied only to paying the necessary expenses for conducting original researches or experiments bearing directly on the agricultural industry of the United States, having due regard to the varying conditions and needs of the respective states and territories."

The purposes for which the funds provided by the Purnell Act may be used are stated as follows: "The funds appropriated pursuant to this Act shall be applied only to paying the necessary expenses of conducting investigations or making experiments bearing directly on the production, manufacture, preparation, use, distribution, and marketing of agricultural products and including such scientific researches as have for their purpose the establishment and maintenance of a permanent and efficient agricultural industry, and such economic and sociological investigations as have for their purpose the development and improvement of the rural home and rural life, and for printing and disseminating the results of said researches."

INVESTIGATIONS

In its investigational work, the Station does not attempt to cover the whole field of agricultural science—with the funds and facilities available, this is impossible. It does attempt to study thoroughly the more important problems connected with a permanent and profitable agriculture for Maine and, as far as changing times will permit, to anticipate these problems in advance. As in the past, diseases of plants and animals, insect pests, breeding of plants and animals, orchard and field experiments, and poultry investigations continue to be important lines of research. As the result of additional funds provided by the Purnell Act, together with a State appropriation for general maintenance, it has been possible to strengthen existing departments, to resume work upon problems or phases of problems of a chemical nature and to establish departments of agricultural economics and home economics with comprehensive programs of research in these important fields.

INSPECTIONS

The State Department of Agriculture is charged with the enforcement of all laws regulating the sale of agricultural seeds, ap-

ples, commercial feeding stuffs, commercial fertilizers, drugs, foods, fungicides and insecticides. The Station is required to make the analyses of the samples of these various materials collected by the inspectors of the Department. The Station is also required to test and mark the graduated glassware used by creameries. The cost of the inspection work is borne by fees, and by a State appropriation.

OFFICES AND LABORATORIES

The offices, laboratories, and poultry plant of the Maine Agricultural Experiment Station are at the University of Maine, Orono. Orono is the freight, express, post, telegraph, and telephone address for the offices and laboratories.

AROOSTOOK FARM

By action of the Legislatures of 1913 and 1915 a farm was purchased in Aroostook County for scientific investigations in agriculture to be under "the general supervision, management, and control" of the Maine Agricultural Experiment Station. The farm is in the town of Presque Isle, about two miles south of the village on one of the main roads to Houlton. The Bangor and Aroostook Railroad crosses the farm.

The farm contains approximately 275 acres, about half of which is cleared. The eight-room house provides an office and home for the farm superintendent. A school house on a lot adjoining the farm was presented to the State by the town of Presque Isle and after being remodeled served as a boarding house for the help. This was destroyed by fire in the fall of 1925 and was replaced by a new building in the spring of 1926. A greenhouse and a potato storage house have been erected at the farm by the U. S. Department of Agriculture for use in co-operative work on potato breeding. The large barn affords storage for hay and grain and has a large basement suitable for potato storage.

HIGHMOOR FARM

The State Legislature of 1909 purchased a farm upon which the Maine Agricultural Experiment Station was directed to "con-

duct scientific investigations in orcharding, corn and other farm crops." The farm is situated largely in the town of Monmouth. It is on the Farmington Branch of the Maine Central Railroad, two miles from Leeds Junction. A flag station, "Highmoor", is on the farm.

The farm as originally purchased includes 225 acres, about 200 of which are in orchards, fields and pastures. About 30 acres of additional orchard land, adjoining the farm, was purchased in July, 1925. There are in the neighborhood of 2,500 apple trees of all ages upon the place. The house has two stories with a large wing, and contains about 15 rooms. It is well arranged for the Station offices and for the home of the farm superintendent. A substantially constructed building for apple packing was erected in 1912.

STATION NOTES

COUNCIL AND STAFF CHANGES

Doctor Fred Griffee was made Director of the Station effective April 17, 1931.

The following changes in the Station staff occurred during the year:

In Biology, Mr. Russell M. Bailey was appointed associate biologist in plant breeding and nutrition on June 1, 1931. Doctor W. Franklin Dove was appointed biologist on July 1, 1931. Mr. Irvin C. Mason was appointed assistant in biology on July 1, 1931.

In Entomology, Mr. Geddes W. Simpson was appointed assistant entomologist on June 1, 1931. Doctor Clarence R. Phipps was appointed entomologist on October 9, 1931.

In Home Economics, Mrs. Myrtle Walker Dow resigned as part-time assistant on June 15, 1931, and was reappointed on November 1, 1931. Miss Lolie Smith was appointed associate home economist on July 1, 1931.

In the Inspections Department, Doctor George P. Steinbauer was appointed seed analyst on March 1, 1931.

PROJECTS FOR 1931-1932

AGRICULTURAL ECONOMICS

Prices of farm products and price trends in Maine.
Farm taxation in Maine.
An economic study of the dairy industry in Maine.
An economic study of the potato industry in Maine.
A study of the factors affecting the quality of Maine potatoes during the harvesting and marketing of the crop. (Maine Development Commission project.)

BIOLOGY

The relation between shape and yield of apple trees.
Breeding new varieties of apples.
Nursery stock investigations in relation to bud selection, root selection, and the reciprocal relation of stock and scion.
A study of the causes of cross and self sterility in the apple through a cytological and genetic study of the sterility and compatibility relationships of different varieties through pollination experiments.
A study of soil and fertilizer requirements of the native Maine blueberry.
The improvement of the horticultural status of the low-bush blueberry.
The mode of inheritance of milk production and associated characters in cattle.
Breeding investigations with garden crops.
Fertilizer experiments with potatoes in rotation with grain and clover.
A study of clover failures in a potato rotation.
A study of various green manuring crops as a means of increasing and maintaining the organic matter content of potato soils in two-, three-, and four-year rotations.
A study of the physiology of reproduction in poultry.
Influence of anti-rachitic substances on growth in poultry.
Fertilizer experiment with sweet corn and beans in a four-year rotation—oats, clover, sweet corn, and beans and with sweet corn in a two-year rotation—sweet corn and an annual green manuring crop (mixture of oats and peas).
A study of the inheritance of certain characters in relation to yield and quality in wheat, oats, barley, sweet corn, beans, and apples.
Cytological studies in species crosses.
Small grain variety test including oats, barley, and wheat.

CHEMISTRY

INSPECTION

Inspection of feeding stuffs.
Inspection of fertilizers.
Inspection of foods and drugs.
Inspection of fungicides and insecticides.

Inspection of seeds.
Inspection of gasolines and oils.
Calibration of creamery glassware.
Inspection of milk and cream.
Miscellaneous analyses.

CHEMISTRY

INVESTIGATION

Chemical composition of cow's milk in parents and hybrid offspring. (In cooperation with the Biology Department.)
Inheritance and physiology of the secretion of milk solids. (In cooperation with the Biology Department.)
Chemical analyses in connection with the problem of nutrition and growth of poultry and dairy cattle. (In cooperation with the Biology Department.)
Soil acidity investigation and analysis of materials used in connection with the permanent rotation and fertility experiments at Aroostook Farm. (In cooperation with the Biology Department.)
Experiments to determine the retentive powers of Aroostook potato soils for mineral nitrogen. (In cooperation with the Biology Department.)
Chemical work, including hydrogen ion determinations, on the differences in potato plants and tubers due to certain degeneration diseases. (In cooperation with the Plant Pathology Department.)
A comparison of copper fungicides as to the adherence of the copper contents to potato foliage in spraying and dusting. (In cooperation with the Plant Pathology Department.)
Miscellaneous analyses.

ENTOMOLOGY

Aphid investigations with special reference to the different food plants of migratory species.
A study of the dispersion habits of the apple maggot.
Insects affecting the blueberry.
Control of the cabbage maggot.
Experiments with sodium and calcium fluosilicates in the control of the cucumber beetle and other insects.
Cutworms affecting field and vegetable crops.
Insects in relation to the transmission of virus diseases of potatoes.
Garden slug control.
Wireworm control.

HOME ECONOMICS

An investigation of the iron content of edible wild greens of Maine.
The economic utilization of electricity in food preparation in Maine rural homes.
An investigation to determine the causes of variation in cooking quality of potatoes.

PLANT PATHOLOGY

Apple scab control.
Blueberry diseases.
Dusting and spraying potatoes.
Potato diseases associated with or related to mosaic, known by such tentative names as curly-dwarf, streak, mosaic-dwarf, crinkle, leaf-drop, Giant-hill, etc.
Potato leafroll, including net-necrosis, stem-end browning, and spindling sprout.
Potato mosaic.
Potato spindle tuber.
Rots of potato tubers and seed pieces.
Seed disinfection of potatoes.
Plant disease survey and miscellaneous diseases. Annual recording, through correspondence and observations, of the prevalence and severity of plant diseases, and preliminary experiments on miscellaneous diseases that develop importance.

PUBLICATIONS

The Station is organized so that the work of investigation is distinct from the work of inspection. The results of investigation are published in the bulletins of the Station and in scientific journals, both foreign and domestic. The bulletins for the year make up the annual report. The results of the work of inspection are printed in publications known as Official Inspections. These are paged independently of the bulletins and are bound with the annual report as an appendix thereto. Miscellaneous publications consisting of newspaper notices of bulletins, newspaper bulletins and circulars which are not paged consecutively and for the most part are not included in the annual report, are issued during the year.

BULLETINS ISSUED IN 1931

No. 358. Comparison of Apparently Healthy Strains and Tuber Lines of Potatoes. 104 pages.
No. 359. Some Economic Phases of the Marketing of Maine Apples. 60 pages.
No. 360. Progress of Investigations, Abstracts of Papers not included in Bulletins, Finances, Meteorology, Index. 67 pages.

OFFICIAL INSPECTIONS ISSUED IN 1931

No. 139. Foods and Drugs. 16 pages.
No. 140. Commercial Feeding Stuffs, 1930-1931. 32 pages.

No. 141. Commercial Fertilizers, 1931. 32 pages.
No. 142. Commercial Agricultural Seeds, 1931. Fungicides and Insecticides, 1931. 40 pages.

PUBLICATIONS FROM THE AGRICULTURAL ECONOMICS LABORATORY IN 1931

Preliminary summary of questionnaires received from 1,802 dairymen in July and August, 1931. By George F. Dow. Farm Economic Facts, November, 1931, pp. 26-27.

Some economic phases of the marketing of Maine apples. By Merton S. Parsons. Annual Report of the Maine Agricultural Experiment Station, Bull. 359, pp. 105-164.

PUBLICATIONS FROM THE BIOLOGICAL LABORATORY IN 1931

Studies on milk secretion. The influence of inanition. By John W. Gowen and Elmer R. Tobey. Journal of General Physiology 15:45-66.

On the mechanism of milk secretion. The influence of insulin and phloridzin. By John W. Gowen and Elmer R. Tobey. Journal of General Physiology 15:67-85.

PUBLICATIONS FROM THE HOME ECONOMICS LABORATORY IN 1931

Paring waste of Maine potatoes. By Myrtle W. Dow. Amer. Potato Jour. 8:6-11.

The relation of storage temperature of potatoes to their culinary quality. By Marion D. Sweetman. Amer. Potato Jour. 8:174-176.

The scientific study of the palatability of food. By Marion D. Sweetman. Jour. Home Econ. 23:161-172.

Penetrometer measurements of "doneness" in cooked vegetables. By Marion D. Sweetman and Mabel C. Lancaster. Jour. Home Econ. 23:565-567.

PUBLICATIONS FROM THE PHYTOPATHOLOGICAL LABORATORY IN 1931

Notes on blueberry diseases in Maine. By Florence L. Markin. Plant Disease Reporter 15:11-14.

Virus diseases of the potato. By Donald Folsom. Potato Assoc. Amer. Proc. 17th Ann. Meeting, Cleveland, 1930. pp. 83-101. (A review.)

Comparison of "healthy" Green Mountain strains and tuber lines in Maine. By Donald Folsom. Potato Assoc. Amer. Proc. 17th Ann. Meeting, Cleveland, 1930. pp. 134-140.

Why potatoes run out. By Donald Folsom. New Hampshire Hort. Soc. 19th Ann. Rpt. for the 36th Ann. Meeting, 1930. pp. 90-98.

Comparison of apparently healthy strains and tuber lines of potatoes. By Donald Folsom, F. V. Owen, and Hugh B. Smith. Annual Report of the Maine Agricultural Experiment Station, Bull. 358, pp. 1-104.

ABSTRACTS OF PAPERS PUBLISHED BY THE STATION IN 1931 BUT NOT INCLUDED IN THE BULLETINS

A complete list of all the publications issued by and from the Station in 1931 is given on pages 213 and 214 of this Report. The following pages contain abstracts of the papers issued during the year that are not included in the Bulletins or Official Inspections.

PRELIMINARY SUMMARY OF QUESTIONNAIRES RECEIVED FROM 1,802 DAIRYMEN IN JULY AND AUGUST, 1931*

Dairymen kept an average of 8.20 cows per herd, of which 15.02 per cent were purebreds. An average of 2.1 heifers per herd was also expected to freshen and become cows during the ensuing year. Dairymen, however, stated that they could produce sufficient roughage and had stable room to keep about 60 per cent more cows. The herds that sold whole milk had slightly larger herds and greater production per cow than did those that sold cream. The pounds of milk or cream delivered per trip were small, averaging 57 pounds per patron delivering to cream plants that shipped out of the State, 122 pounds per patron delivering to milk plants that shipped out of the State, and 138 pounds per patron delivering milk to be retailed in Maine.

The average distance from the farm to the milk plant or creamery was 13.26 miles, of which 1.46 miles were unimproved road. Hauling distances were rather high due to the extensive use of many relatively long collection routes. An average of 77.31 per cent of the dairymen hired milk and cream hauled by a collection route; 4.27 per cent shipped on the railroad; and 18.42 per cent delivered milk and cream themselves at the receiving plants. About eight dairymen lived within a two-mile radius of each dairy farm. The average cost for hauling milk, delivered to plants shipping out of the State, was 35.1 cents per hundredweight. The average

*This is an abstract of a mimeographed report by George F. Dow sent to owners and managers of the larger milk plants and creameries in Maine; and also published in summarized form in Farm Economic Facts, November, 1931, pp. 26-27.

cost for hauling cream, delivered to plants shipping out of the State, was 85.5 cents per hundredweight or slightly over five cents per pound of butter-fat.

These data were published in table form and included summaries not only of the State as a whole but of each type of plant, including milk and cream plants shipping out of the State, local milk and cream plants with retail trade, and ice cream plants.

STUDIES ON MILK SECRETION
THE INFLUENCE OF INANITION*

In this paper data are presented on cows receiving no food but having access to all of the water which they wished. The yield and composition of the milk were determined at various times during the periods of starvation. The composition of the milk showed changes which were progressive in the sense that they followed a definite course. They were characterized by a marked lowering in the amount of milk produced, by an increase in the total solids (chiefly an increase in the percentage of fat and ash, with a slight increase in proteins) and by a pronounced decrease in the lactose. The decrease in lactose corresponded with a decrease in the dextrose content of the blood, thereby supporting the conclusion that the lactose of milk has as its precursor dextrose of the blood. All the changes in milk composition during starvation can be directly related to the simultaneous changes in the blood.

ON THE MECHANISM OF MILK SECRETION
THE INFLUENCE OF INSULIN AND PHLORIDZIN†

The results presented in this article are supplementary to those published in a previous paper[1] and furnish data to show the effect,

*This is an abstract of a paper by John W. Gowen and Elmer R. Tobey, having the same title and published in the Journal of General Physiology 15:45-66. 1931.

†This is an abstract of a paper by John W. Gowen and Elmer R. Tobey, having the same title and published in the Journal of General Physiology 15:67-85. 1931.

[1]Studies on milk secretion. The influence of inanition. By John W. Gowen and Elmer R. Tobey. Journal of General Physiology 15:45-66. 1931.

on milk secretion, of the introduction of insulin and phloridzin into the blood stream.

Starvation lowers the blood sugar and raises the osmotic pressure of the blood. Since insulin produces a marked and rapid drop in blood sugar it too may be looked upon as a rapid starvation effect. In the starvation experiments the butter-fat percentage of the milk rises rather uniformly with the duration of starvation. In the insulin experiments, however, there is a marked reduction in the butter-fat percentage immediately after the introduction of insulin. Since the dextrose of the blood tends to be reduced and made unavailable to the general physiological processes by the presence of the large excess of insulin, and since this reduction of the butter-fat percentage is noted as an accompanying phenomenon, it would appear that the blood dextrose plays a part in the synthesis of milk fat, as well as being the source of the lactose, possibly as a source of energy in converting body fat to butter-fat. The effects of starvation and of insulin furnish concordant proof for the theory that the lactose of milk is derived from the sugar of the blood.

Phloridzin lowers the threshold for sugar retention, tends to depress the potassium, to increase the phosphorus content of the blood and to cause the body to burn protein rather than carbohydrate, thus increasing nitrogen excretion.

The fact that the different constituents of the milk do not exactly parallel each other in their behavior throughout these experiments indicates that they have in all probability separate origin. The wide variation brought about in the constituents points to the conclusion that in milk secretion a balance is maintained between osmotic pressure of the milk and of the blood.

These experiments give direct proof for the conclusion that modifications of the blood of dairy cattle produce direct and predictable modification of the milk secreted.

PARING WASTE OF MAINE POTATOES*

The relative loss in hand paring of potatoes decreases with an increase in size of the tubers. Therefore large potatoes are more economical to pare. They are also more attractive in appearance

*This is an abstract of a paper by Myrtle Walker Dow having the same title and published in Amer. Potato Jour. 8:6-11. 1931.

than are small ones, at least up to certain size, varying with local and personal preferences and intended use. In machine paring uniformity is the most important quality so far as size is concerned.

Shape generally is not so important as size in affecting loss from hand paring but it is a very important factor in machine paring. Potatoes for commercial use should be of a regular and uniform shape.

Deep eyes may add ten per cent more to total paring waste than shallow eyes. For machine paring especially, shallow eyes are definitely preferable.

The variation in size and paring waste in different lots of potatoes graded as U. S. No. 1 is such that there seems to be a need for closer grading both with respect to size and defects.

A study of methods to minimize cuts and bruises and accompanying rot would be of great importance to both the producer and the consumer.

THE RELATION OF STORAGE TEMPERATURE OF POTATOES TO THEIR CULINARY QUALITY*

The fact that temperatures below 40° F. cause potatoes to accumulate sugar was pointed out many years ago but it is still recommended that storage cellars for tubers for culinary use be held at temperatures as low or lower. Frying quality is thus damaged greatly on account of the bitter flavor and dark color caused by caramelization of the sugar. The sweet flavor may be objectionable in such potatoes prepared by any method and mealiness is said to be diminished. Storage at warm temperatures for more or less prolonged periods will cause the sugar to be removed but this is not a very practical remedy. Storage temperatures for potatoes should be studied to determine which range of temperature will give least culinary injury due to sugar accumulation and still secure desirable retardation of germination.

*This is an abstract of a paper by Marion Deyoe Sweetman having the same title and published in Amer. Potato Jour. 8:174-176. 1931.

THE SCIENTIFIC STUDY OF THE PALATABILITY OF FOOD*

The scientific study of the palatability of food consists of the measurement of the intensity of the sensation-producing qualities of food and the rating of these intensities according to preference. The sensation-producing qualities of foods may be measured by comparison with scales or by objective technics and apparatus which give a numerical evaluation. Scales should be concrete, and ideally the variations included should be evaluated numerically.

Palatability ratings for each intensity of the qualities studied should be based on preference studies. These may be demand surveys, studies of price premiums paid for intensities of a quality, or controlled preference tests. Generalizations should be restricted to the groups whose preferences have been studied, since food preferences depend on custom and the experience of the individual.

The commonly used score cards are not scientifically adequate means of recording palatability. They are subject to all of the weaknesses of imaginary scales, and the relative evaluation of different qualities is arbitrarily arrived at.

PENETROMETER MEASUREMENTS OF "DONENESS" IN COOKED VEGETABLES†

This paper describes the technic developed with a commercial penetrometer to measure rate of softening of potato slices during cooking.

NOTES ON BLUEBERRY DISEASES IN MAINE‡

The species of blueberries yielding the commercial crop are native, the chief one being *Vaccinium pennsylvanicum* Lam. The

*This is an abstract of a paper by Marion Deyoe Sweetman having the same title and published in Jour. Home Econ. 23:161-172. 1931.

†This is an abstract of a paper by Marion Deyoe Sweetman and Mabel C. Lancaster having the same title and published in Jour. Home Econ. 23: 565-567. 1931.

‡This is an abstract of a paper by Florence L. Markin having the same title and published in The Plant Disease Reporter 15:11-14. 1931.

fields mostly originated as cleared woodlands and old farm lands which became occupied by the blueberries. There are a few planted areas. "Cultivation" consists of weed control with a "high-bush" species (*V. corymbosum* L.) and consists of weed control and burning with "low-bush" species (*V. pennsylvanicum, V. canadense* Kahm., and others). The prevalence of many different clones makes accurate determinations of yields and disease losses impossible.

Witches' broom (*Calyptospora columnaris* Kuhn.) is frequent and sometimes serious, is not controlled by burning, and is aggravated by proximity to woodland because of its having a stage on balsam fir (*Abies balsamea* (L.) Mill.). This disease has attacked New Jersey varieties of high-bush blueberries in the Station nursery where the native Maine low-bush blueberries were little affected. Leaf rust (*Pucciniastrum myrtilli* Arth.) is general and sometimes abundant, causes some defoliation, and is aggravated by proximity to woodland because of its having a stage on hemlock (*Tsuga canadensis* (L.) Carr.). Red leaf spot (*Exobasidium vaccinii* Wor.) is widely distributed, is not serious, and is controlled to some extent by burning. A Sclerotinia twig-blight and fruit-rot disease was severe, in small areas, in 1929 but not in 1930. A botrytis blossom-blight and fruit-rot disease was common in 1930 but not in 1929. Mildew (*Microsphaera alni* var. *vaccinii* (S.) Sal.) is common and causes early defoliation. The severity of attack by this disease varies greatly from plant to plant on *V. corymbosum* in York County.

The preceding diseases are the common ones, and they occur on at least twelve species of plants, the hosts being listed for each disease in the original article. New hosts are *V. canadense* and *V. corymbosum* for *Exobasidium vaccinii,* and *V. uliginosum* for *Calyptospora columnaris.*

Calcium arsenate applied in excess causes burning, spotting, defoliation, and fruit shrinkage. The leaf spotting of arsenical injury might be confused with that due to pathogens.

COMPARISON OF "HEALTHY" GREEN MOUNTAIN STRAINS AND TUBER LINES IN MAINE*

The general problem was the determination of the relative effects of disease, environment, and inheritance upon yield, type, and other characteristics of potato stocks passing as Green Mountains. This variety had been studied in the region with regard to recognizable viroses. There is yet lacking the inoculation of different parts of virus-free stocks respectively with virus diseases and subsequent study of the effects, assuming that environmental and genetic factors could be made sufficiently uniform. It is improbable that a uniform field will be found. Healthy stock and a uniform field would permit the accurate study of "bud sports". Without these ideal conditions being available at present, it may be practicable and desirable to compare various combinations of health, environment, and strain. It is concluded from the available results that at the present time smaller reward can be expected from comparisons of apparently healthy commercial strains and from selections of tuber lines, than from comparisons or selections with respect to variety, recognizable diseases, soil conditions, climate, fertilizer, etc.

WHY POTATOES RUN OUT†

Potatoes run out or degenerate because of certain diseases of the mosaic-streak, leafroll, and spindle-tuber types. All Green Mountain plants tested so far have been found to contain mosaic of a kind disclosed only by taking the juice to tobacco, Jimson weed, or other potato varieties. Yield in Green Mountains is reduced about 20 per cent by mild mosaic, about 50 per cent by rugose mosaic, about 20 per cent by spindle tuber, and about 50 per cent by leafroll. Streak in Green Mountains shows no mottling, but taken

*This is an abstract of a paper by Donald Folsom having the same title and published in the Potato Assoc. Amer. Proc. 17th Ann. Meeting, Cleveland, 1930, pp. 134-140. 1931. The detailed results are available in Bulletin 358 and therefore are not covered in this abstract.

†This is an abstract of the newer data in a paper by Donald Folsom having the same title and published in the New Hampshire Hort. Soc. 19th Ann. Rpt., for the 36th Ann. Meeting, 1930, pp. 90-98. 1931.

to Spaulding Rose gives a good mosaic. Its effects are severe and it does not persist in commercial Green Mountain fields in Aroostook County. Giant hill can reduce the yield even when lengthening the growing season through frost resistance, but if it has any spread the latter is of no consequence in Maine. Leafroll spreads more in southern Maine than in the northern part, sometimes spreading 900 feet. Mild mosaic increases enough in northern Maine to be serious. Apparently the climate to the north and east is progressively less favorable to the spread of these diseases. In Maine the best methods of raising seed include the roguing of isolated tuber-unit seed plots. Tuber units make roguing most effective because nearly all degeneration disease permeates tubers completely; this results in the grouping of diseased plants in certain tuber units, which makes disease conspicuous earlier, makes disease more conspicuous, makes roguing faster and easier, makes possible the roguing of some diseased plants before they show symptoms, and reduces the number of places from which disease can be spread by insects before roguing is completed.

METEOROLOGICAL OBSERVATIONS

For many years the meteorological records were made at the Experiment Station by members of the Station staff. This work was transferred to the Department of Physics of the University of Maine on June 1, 1911. The Station is indebted to the Department of Physics for the meteorological summary for 1931 which appears on the following page.

The instruments used are located on the University campus at Lat. 44° 54′ 2″ N., Lon. 64° 40′ 5″ W. Elevation 135 feet. They are the same as those used in preceding years and include: maximum and minimum thermometers, rain gauge, self-recording anemometer, vane, and barometers. The observations at Orono now form an almost unbroken record of sixty-three years.

METEOROLOGICAL SUMMARY FOR 1931

1931	January	February	March	April	May	June	July	August	September	October	November	December	Average	Total
Highest temperature	45	51	68	85	97	94	97	94	94	82	77	48		
Lowest temperature	–19	–21	16	23	28	40	43	37	30	23	11	–1		
Mean temperature	20.38	24.25	36.98	45.18	55.85	60.88	69.14	66.00	57.65	51.45	41.20	24.20	46.10	
Mean temperature in 63 years	16.21	18.99	30.21	39.10	50.58	61.21	67.15	65.70	59.17	49.28	37.55	23.06	43.28	
Total precipitation in inches	1.66	1.60	1.47	1.78	2.58	4.65	7.63	5.48	4.18	6.31	1.06	2.67		41.07
Mean total precipitation in 63 years	3.87	3.45	3.73	2.80	3.33	3.39	3.42	3.44	3.45	3.93	3.55	3.57		41.93
Number of days with .01 inch precipitation or more	5	9	7	7	11	11	13	8	9	9	8	9		106
Snowfall in inches	22.0	15.0	11.5	6.5							Trace	4.6		59.6
Mean snowfall in 63 years	21.6	21.5	14.1	5.7						0.74	6.1	15.9		85.6
Number of clear days	20	11	13	15	17	17	17	17	15	19	12	12		185
Number of partly cloudy days	7	9	12	12	5	6	7	11	7	4	11	14		105
Number of cloudy days	4	8	6	3	9	7	7	3	8	8	7	5		75
Average wind velocity in miles per hour	2.91	3.89	4.05	5.17	4.67	4.70	4.03	2.39	4.14	4.02	4.49	4.79	4.10	

REPORT OF THE TREASURER

The Station is a department of the University and its accounts are kept in the office of the Treasurer of the University. The books, voucher files, etc., are, however, all distinct from those of the other departments of the University. The classification of accounts is that prescribed by the auditors on the part of the Federal Government, and approved by the State Auditor. All of the accounts are audited by the State Auditor, and the Hatch Fund, Adams Fund, and Purnell Fund accounts are also audited by the Office of Experiment Stations acting for the United States Secretary of Agriculture in accordance with federal law.

The income of the Station from federal and state appropriations for the year that ended June 30, 1931, was:

U. S. Government, Hatch Fund	$15,000.00
U. S. Government, Adams Fund	15,000.00
U. S. Government, Purnell Fund	60,000.00
State of Maine, General Maintenance	35,000.00

The cost of maintaining the laboratories for the inspection analyses is borne by analysis fees and by the State Department of Agriculture. The income from sales at the experimental farms and the poultry plant is used for the expense of investigations. The printing is paid for by an appropriation to the University.

At Aroostook Farm there are in connection with the cooperative work with the Federal Department of Agriculture certain expenditures for the Department made from sales of crops from Department investigations that do not appear in the tabular statements. They are carried as distinct and separate accounts, always with credit balances on the Station ledger.

REPORT OF THE TREASURER FOR YEAR ENDING JUNE 30, 1931

DISBURSEMENTS

	Hatch Fund	Adams Fund	Purnell Fund	State Maintenance
Salaries	$ 8,321.30	$14,944.48	$40,372.47	$ 4,515.23
Labor	2,288.00		2,622.89	5,883.10
Stationery and Office Supplies	55.93		120.67	472.24
Scientific Supplies			544.44	124.17
Feeding Stuffs	1,485.81		1,653.03	836.40
Sundry Supplies			1,032.21	1,605.76
Fertilizers			179.36	515.35
Communication Service	22.27		34.75	336.19
Travel Expenses	193.53	55.52	5,246.67	601.27
Transportation of Things	69.00		168.19	295.16
Publications			16.65	126.21
Heat, Light, Water and Power	1,416.68		477.77	1,013.28
Furniture, Furnishings and Fixtures	407.90		1,041.65	375.67
Library	739.58		100.03	291.60
Scientific Equipment			3,878.58	267.24
Live Stock				
Tools, Machinery and Appliances			1,420.47	1,501.06
Buildings and Land			633.95	1,077.63
Contingent Expenses			456.22	162.44
Total	$15,000.00	$15,000.00	$60,000.00	$20,000.00

REPORT OF THE TREASURER FOR YEAR ENDING JUNE 30, 1931

DISBURSEMENTS

	Aroostook Farm	Highmoor Farm	Animal Husbandry	General Account	Inspection Analyses
Salaries	$1,600.00	$2,000.00	$	$ 92.33	$10,514.38
Labor	2,467.02	2,091.83	2,851.50	1,905.02	97.75
Stationery and Office Supplies				100.34	
Scientific Supplies			13.11	55.62	268.84
Feeding Stuffs	101.70		2,939.44	18.40	
Sundry Supplies	166.24	588.39	225.51	142.99	54.36
Fertilizers	1,128.82				
Communication Service	10.35	60.88		48.25	51.75
Travel Expenses				507.37	
Transportation of Things	25.06	11.71	28.58	61.42	123.72
Publications	18.08				
Heat, Light, Water and Power	96.09	164.38	714.86	169.80	426.74
Furniture, Furnishings and Fixtures	73.89	264.41	3.60	158.95	29.73
Library				115.41	18.41
Scientific Equipment				764.11	353.05
Live Stock					
Tools, Machinery and Appliances	1,070.58	814.93	187.05	76.18	
Buildings and Land	105.61	69.05		115.05	51.27
Contingent Expenses	13.24	23.96	228.02	248.50	10.00
Total	*$6,876.68	†$6,089.54	‡$7,191.67	$4,579.74	$12,000.00

*$1,876.68 from sales fund.
†$1,089.54 from sales fund.
‡$2,191.67 from sales fund.

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Warner Jackson Morse